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JP**(54) SPACER FOR LIQUID CRYSTAL DISPLAY ELEMENT AND LIQUID CRYSTAL DISPLAY ELEMENT USING THAT****(57)Abstract:**

PROBLEM TO BE SOLVED: To add functions such as a preventing performance against abnormal orientation and an adhesive performance to a shell layer while maintaining the mechanical strength required for a spacer by reacting an oxidant with fine particles each having reducing groups on the surface to produce radicals on the particle surface and forming a polymer layer by using the radicals as the starting point on the particle surface.

SOLUTION: An oxidant is reacted with fine particles each having reducing groups on the surface to produce radicals on the particle surface. Then polymerizable monomers are reacted by using the radicals as the starting point to form a polymer layer on the particle surface. As for the oxidant, for example, persulfates, cerium salt, hydrogen peroxide, dimethylaniline, sodium periodate, potassium permanganate and alkylboron are used. Further, an acid such as nitric acid or its salt may be added so as to increase the reaction rate of the polymer system. As for the reducing groups, for example, hydroxyl groups, thiol groups, aldehyde groups, mercapto groups and amino groups are used.

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CLAIMS

[Claim 1a]

[Claim 1] The spacer for liquid crystal display components characterized by making an oxidizing agent react to the particle which has a reducibility radical on a front face, making said particle front face generate a radical, and making it come with this radical as the starting point to form a polymerization layer in said particle front face.

[Claim 2] The spacer for liquid crystal display components according to claim 1 whose oxidizer is a cerium salt.

[Claim 3] The spacer for liquid crystal display components characterized by making it come by making an oxidizing agent react to the particle which has a reducibility radical on a front face, making said particle front face generate a radical, and making the polymerization nature monomer which has an epoxy group with this radical as the starting point react to form a reactant graft polymerization layer in said particle front face.

[Claim 4] The spacer for liquid crystal display components characterized by making it come by making an oxidizing agent react to the particle which has a reducibility radical on a front face, making said particle front face generate a radical, and making the polymerization nature monomer which has the polymerization nature monomer and ethylene glycol radical which have an epoxy group with this radical as the starting point react to form a reactant graft polymerization layer in said particle front face.

[Claim 5] The spacer for liquid crystal display components characterized by making it come by making an oxidizing agent react to the particle which has a reducibility radical on a front face, making said particle front face generate a radical, and making the polymerization nature monomer which has a long-chain alkyl group with this radical as the starting point react to form in said particle front face the graft polymerization layer which has a long-chain alkyl group.

[Claim 6] The spacer for liquid crystal display components which is made to form in said particle front face the graft polymerization layer which has a functional group, and is further characterized by to make a long-chain alkyl compound come to react to the graft polymerization layer which has said functional group by making an oxidizing agent react to the particle which has a reducibility radical on a front face, making said particle front face generate a radical, and making the polymerization nature monomer which has a functional group with this radical as the starting point react.

[Claim 7] By making an oxidizing agent react to the particle which has a reducibility radical on a front face, making said particle front face generate a radical, and making the polymerization nature monomer which has a functional group with this radical as the starting point react. The graft polymerization layer which has a functional group is made to form in said particle front face. Further By making the polymerization nature monomer which has an epoxy group react to it, after introducing the active group which has a polymerization nature vinyl group and/or polymerization initiation ability into the graft polymerization layer which has said functional group. The spacer for liquid crystal display components characterized by making it come to form the graft polymerization layer which has an epoxy group in the graft polymerization layer front face which has said functional group.

[Claim 8] By making an oxidizing agent react to the particle which has a reducibility radical on a

front face, making said particle front face generate a radical, and making the polymerization nature monomer which has a functional group with this radical as the starting point react. The graft polymerization layer which has a functional group is made to form in said particle front face. Further By making the polymerization nature monomer which has a long-chain alkyl group react to it, after introducing the active group which has a polymerization nature vinyl group and/or polymerization initiation ability into the graft polymerization layer which has said functional group. The spacer for liquid crystal display components characterized by making it come to form the graft polymerization layer which has a long-chain alkyl group in the graft polymerization layer front face which has said functional group.

[Claim 9] The liquid crystal display component characterized by for two glass substrates with which the orientation film and a transparent electrode have been arranged counteracting through the spacer for liquid crystal display components according to claim 1, 2, 3, 4, 5, 6, 7, or 8, and enclosing liquid crystal between said glass substrates.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the liquid crystal display component which used the spacer for liquid crystal display components, and it.

[0002]

[Description of the Prior Art] The liquid crystal display component in the Twisted Nematic (TN) mode using the conventional spacer. The pneumatic liquid crystal 11 enclosed between one pair of substrates 8 and 10, and these substrates 8 and 10 as shown in drawing 1. In order to make into a component the seal member 1 with which the perimeter of substrates 8 and 10 was filled up, and the polarization sheets 12 and 13 covered by the front face of substrates 8 and 10 and to hold uniformly the gap between the one above-mentioned pair of substrates 8, and 10, the spacer 9 is arranged between a substrate 8 and 10.

[0003] The above-mentioned substrates 8 and 10 form the pattern of the transparent electrodes 3 and 6 which become one side of the glass transference substrates 2 and 5 from the ITO film etc., and are obtained by covering the orientation control film 4 and 7 which becomes the front face of these transparent electrodes 3 and 6 and the transference substrates 2 and 5 from the polyimide film etc. Orientation control processing is performed to the above-mentioned orientation control film 4 and 7 by rubbing.

[0004] Generally as the above-mentioned charge of spacer 9 material, organic or an inorganic material is used. As a spacer of an inorganic material, the thing containing an aluminum oxide, a silicon dioxide, etc. is mentioned (for example, reference, such as JP.63-73225A and JP.1-59974A). However, since the orientation film was damaged since the degree of hardness is high, or the thickness change by thermal expansion and contraction was not able to follow in footsteps of a substrate easily, the spacer of the conventional inorganic material caused poor gap unevenness.

[0005] Moreover, the spacer of an organic material has the moderate degree of hardness which does not damage the orientation film, tends to follow in footsteps of change of the thickness by thermal expansion or the heat shrink, and has the descriptions, like there is still less spacer migration within a cell, and the polymer of a polystyrene system or a benzoguanamine system is mainly used (for example, reference, such as JP.60-200228A and JP.1-293318A).

[0006] However, the liquid crystal display produced using the above-mentioned spacer had the problem that the abnormality orientation of liquid crystal occurred in the circumference of a liquid crystal spacer, immediately after production of a cell (henceforth a "initial state"), and after high-voltage impression. In the display which used especially super-twisted-nematic (STN) liquid crystal, the inclination became remarkable and there was a trouble that a homogeneous image could not be held. The cause of this abnormality orientation is for a liquid crystal molecule to carry out orientation to the circumference of a spacer, and the size of this abnormality orientation is further presumed to be a thing depending on extent of the orientation of a liquid crystal molecule.

[0007] In order to solve such abnormality orientation, the dielectric constant (refer to JP.6-67182A) of a spacer and examination which changes a spacer surface presentation (refer to

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front face, making said particle front face generate a radical, and making the polymerization nature monomer which has a long-chain alkyl group with this radical as the starting point react.

[0017] The spacer for liquid crystal display components according to claim 6 (henceforth "this invention 5") By making an oxidizing agent react to the particle which has a reducibility radical on a front face, making said particle front face generate a radical, and making the polymerization nature monomer which has a functional group with this radical as the starting point react. It is the spacer for liquid crystal display components which is made to form in said particle front face the graft polymerization layer which has a functional group, and is further characterized by making a long-chain alkyl compound come to react to the graft polymerization layer which has said functional group.

[0018] The spacer for liquid crystal display components according to claim 7 (henceforth "this invention 6") By making an oxidizing agent react to the particle which has a reducibility radical on a front face, making said particle front face generate a radical, and making the polymerization nature monomer which has a functional group with this radical as the starting point react. The graft polymerization layer which has a functional group is made to form in said particle front face. Further By making the polymerization nature monomer which has an epoxy group react to it, after introducing the active group which has a polymerization nature vinyl group and/or polymerization initiation ability into the graft polymerization layer which has said functional group. It is the spacer for liquid crystal display components characterized by making it come to form the graft polymerization layer which has an epoxy group in the graft polymerization layer front face which has said functional group.

[0019] The spacer for liquid crystal display components according to claim 8 (henceforth "this invention 7") By making an oxidizing agent react to the particle which has a reducibility radical on a front face, making said particle front face generate a radical, and making the polymerization nature monomer which has a functional group with this radical as the starting point react. The graft polymerization layer which has a functional group is made to form in said particle front face. Further By making the polymerization nature monomer which has a long-chain alkyl group react to it, after introducing the active group which has a polymerization nature vinyl group and/or polymerization initiation ability into the graft polymerization layer which has said functional group. It is the spacer for liquid crystal display components characterized by making it come to form the graft polymerization layer which has a long-chain alkyl group in the graft polymerization layer front face which has said functional group.

[0020] A liquid crystal display component (henceforth "this invention 8") according to claim 9 is a liquid crystal display component characterized by two glass substrates with which the orientation film and a transparent electrode have been arranged counter through the spacer for liquid crystal display components according to claim 1, 2, 3, 4, 5, 6, 7, or 8, and enclosing liquid crystal between said glass substrates.

[0021] The spacer for liquid crystal display components of this invention 1 makes it come to form the shell layer which consists of a polymerization nature monomer in the front face of the particle which is the so-called core shell type of spacer, and is a core.

[0022] Since the particle used in this invention 1 functions as a core particle of the spacer for liquid crystal display components, various engine performance is required in particle size, particle size distribution, dynamics reinforcement, etc.

[0023] The particle size of the above-mentioned particle has desirable 1-10 micrometers. The particle size distribution of the above-mentioned particle is the CV value which broke standard deviation by particle size, and is desirable. [10% or less of] As for the dynamics reinforcement of the above-mentioned particle, it is desirable that 10% K value is 250-1000. Since the reinforcement of a particle was not enough, in case a liquid crystal display component was constructed as it is less than 250, when a spacer is destroyed, and a suitable gap does not come out, but 1000 was exceeded and it includes in a liquid crystal display component, the orientation film on a substrate is damaged and the abnormalities in a display occur.

[0024] In addition, above-mentioned 10% K value — the Patent Publication Heisei No. 503180 [six to] official report — being based — a minute compression test machine (PCT-200, Shimadzu Corp. make) — using — the smooth end face of a cylinder with a diameter [made

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JP.6-118421A) are performed. However, in order to prevent abnormality orientation, after changing the presentation of a polymer a lot, it became a brittle particle without reinforcement required for a spacer, and there was a problem destroyed in case a liquid crystal display component is constructed.

[0008] Moreover, migration of a spacer took place by vibration at the time of impregnation of liquid crystal and the conveyance after production etc., and the liquid crystal display produced using the conventional spacer had the problem from which this migration part serves as display nonuniformity. Especially, by the spread of television for mount, navigation systems, etc., since the use opportunity of the liquid crystal display in the intense location of vibration is increasing, recent years require the adhesive high spacer more.

[0009] having also covered adhesion layers which have the adhesion over a substrate on a particle front face, such as synthetic resin of a low-melt point point, and a wax, to such a demand — although — it is proposed (refer to JP.63-94224A). However, such a spacer had the problem of an adhesion layer having exfoliated [tend] from a particle front face, and the adhesion layer which exfoliated having mixed in liquid crystal, and reducing the display engine performance of a liquid crystal display.

[0010] Then, the so-called core shell type which considers only a particle front face as the presentation suitable for abnormality orientation prevention and the presentation excellent in adhesion of spacer is examined with reinforcement with the sufficient interior of a particle. However, the whole front face could not be embellished in homogeneity, and the problem of actuation of a complicated multistage story being required was left behind to making a shell layer.

[0011]

[Problem(a) to be Solved by the Invention] This invention aims at offering the spacer for liquid crystal display components of the core shell type which gave functionality, such as abnormality orientation prevention engine performance and adhesive ability, to the shell layer, and the liquid crystal display component using it, holding the dynamics reinforcement needed for a spacer in view of the above.

[0012]

[Means for Solving the Problem] The spacer for liquid crystal display components according to claim 1 (henceforth "this invention 1") is a spacer for liquid crystal display components which makes an oxidizing agent react to the particle which has a reducibility radical on a front face, makes the above-mentioned particle front face generate a radical, and makes it come with this radical as the starting point to form a polymerization layer in the above-mentioned particle front face.

[0013] The spacer for liquid crystal display components according to claim 2 is a spacer for liquid crystal display components according to claim 1 whose oxidizer is a cerium salt.

[0014] The spacer for liquid crystal display components according to claim 3 (henceforth "this invention 2") is a spacer for liquid crystal display components characterized by making it come to form a reactant graft polymerization layer in said particle front face by making an oxidizing agent react to the particle which has a reducibility radical on a front face, making said particle front face generate a radical, and making the polymerization nature monomer which has an epoxy group with this radical as the starting point react.

[0015] The spacer for liquid crystal display components according to claim 4 (henceforth "this invention 3") Make an oxidizing agent react to the particle which has a reducibility radical on a front face, make said particle front face generate a radical to it, and it starts from this radical to it. By making the polymerization nature monomer which has the polymerization nature monomer and ethylene glycol radical which have an epoxy group react, it is the spacer for liquid crystal display components characterized by making it come to form a reactant graft polymerization layer in said particle front face.

[0016] The spacer for liquid crystal display components according to claim 5 (henceforth "this invention 4") is a spacer for liquid crystal display components characterized by making it come to form in said particle front face the graft polymerization layer which has a long-chain alkyl group by making an oxidizing agent react to the particle which has a reducibility radical on a

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from a diamond] of 50 micrometers — it is — the above-mentioned particle — the compression degree of hardness of 0.27g/second, and the maximum trial — too heavy — it is the value which compresses by 10g and is calculated from the following formula.

[0025] $R=1/K$ ($K=3/\sqrt{a}$) and $F=S-3/2$ and $1/2F$. The too heavy value in 10% compression set of a particle (kg)

S: the compression in 10% compression set of a particle — a variation rate (mm)

R: The radius of a particle (mm)

[0026] In this invention 1, the above-mentioned particle has a reducibility radical on a front face. It is not limited especially as the above-mentioned reducibility radical, for example, a hydroxyl group, a thiol group, an aldehyde group, a sulphydryl group, the amino group, etc. are mentioned.

[0027] The approach using the approach; macromolecule protective agent are not limited especially as an approach of obtaining the particle which has the above-mentioned reducibility radical on a front face, for example, according to polymerization methods, such as an emulsion polymerization, a suspension polymerization, a seed polymerization, a distributed polymerization, and a distributed seed polymerization; the approach using a surfactant etc. is mentioned. Moreover, the non-subtlety particle which has the above-mentioned reducibility radical on a front face may be used.

[0028] As an approach by the describing [above] polymerization method, copolymerization of a reducibility radical content monomer, and the above-mentioned reducibility radical content monomer, the monomer of copolymerizable others and/or the above-mentioned reducibility radical content monomer and a copolymerizable cross-linking monomer is carried out, for example, and a particle is obtained.

[0029] It is not limited especially as a reducibility radical of the above-mentioned reducibility radical content monomer, for example, a hydroxyl group, a thiol group, an aldehyde group, a sulphydryl group, the amino group, etc. are mentioned. It is not limited especially as the above-mentioned reducibility radical content monomer, for example, acrylic ester (meta) derivative; styrene derivative; vinyl ester; conjugated dienes, such as hydroxyethyl (meta) acrylate, hydroxypropyl (meta) acrylate, hydroxy butyl (meta) acrylate, 2-methacryloxyethyl succinic acid, 2-methacryloxyethyl phthalic acid, monochrome [2] (meta) acryloxyethyl acid phosphate, glycerol monochrome (meta) acrylate, and GURSERDANJ (meta) acrylate, are mentioned. [0030] If it is not limited especially as the above-mentioned reducibility radical content monomer and a monomer of copolymerizable others but the particle of a macromolecule is obtained. For example, styrene, alpha methyl styrene, p-methyl styrene, p-chloro styrene, Styrene derivatives, such as chloro methyl styrene; A vinyl chloride, vinyl acetate, vinyl ester [such as propionic acid vinyl] — unsaturated nitrile [such as acrylonitrile] (meta) — a methyl acrylate — An ethyl acrylate, butyl acrylate (meta), 2-ethylhexyl acrylate (meta), (Meta) Acrylic acid stearyl, ethylene glycol (meta) acrylate, (Meta) Acrylic ester (meta) derivatives, such as trifluoroethyl (meta) acrylate, pentafluoro propyl (meta) acrylate, and cyclohexyl (meta) acrylate; conjugated dienes, such as a butadiene and an isoprene, are mentioned.

[0031] It is not limited especially as the above-mentioned reducibility radical content monomer and a copolymerizable cross-linking monomer, for example, a divinylbenzene, polyethylene GURDKORUJ (meta) acrylate, 1, 6-hexane JIORUJ (meta) acrylate, neopentyl GURDKORUJ (meta) acrylate, TORIMECHI roll pro pantry (meta) acrylate, tetra-methyl METANTORI (meta) acrylate, tetramethylol propane tetrapod (meta) acrylate, diallyl phthalate and its isomer, triallyl isocyanurate, its derivative, etc. are mentioned.

[0032] Moreover, it has a reacting point in the side chain of radical polymerization nature monomers, such as gamma-methacryloxypropyl trimethoxy silane, a particle may be made, and what gave sufficient dynamic reinforcement by the crosslinking reaction of a side-chain part may be used.

[0033] The above-mentioned reducibility radical content monomer, the above and other monomers, and the above-mentioned cross-linking monomer may be used independently, and may use two or more sorts together. However, it is desirable to make the above-mentioned cross-linking monomer into 30% or more in [all] a monomer from a viewpoint of the reinforcement of the spacer for liquid crystal display components obtained.

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[0034] It is not limited especially as a polymerization initiator used in case copolymerization of the above-mentioned reducibility radical content monomer, and the above and other monomers and/or the above-mentioned cross-linking monomers is carried out. For example, a benzoyl peroxide, lauroyl peroxide, an orthoformate chloro benzoyl peroxide, An orthoformate methoxy benzoyl peroxide, 3 and 5, 5-trimethylhexanoyl peroxide, Organic peroxide, such as t-butylperoxy-2-ethylhexanoate and G (t-butyl) peroxide, azo system compounds, such as azobisisobutyronitrile, azobis cyclohexa carbonitrile, and azobis (2,4-dimethylvaleronitrile), etc. are mentioned. The amount of the above-mentioned polymerization initiator used usually has desirable 0.1 ~ 10 weight section to a total of 100 weight sections of a monomer.

[0035] The above-mentioned reducibility radical content monomer, the above and other monomers, the above-mentioned cross-linking monomer, and the above-mentioned polymerization initiator may also teach the whole quantity first, and after they teach a part, they may supply the remainder gradually or continuously. In order to prevent the polymerization control by oxygen on the occasion of a polymerization, inert gas, such as nitrogen, may permeate the system of reaction, and it may be performed. Moreover, on the occasion of a polymerization, a distributed stabilizer can also be used if needed. As the above-mentioned distributed stabilizer, the surfactant of a meltable macromolecule, nonionicity, or ionicity etc. can be suitably used into a medium.

[0036] As an approach using the above-mentioned macromolecule protective agent, the approach of introducing a reducibility radical into the front face of the particle obtained etc. is mentioned, for example by using the macromolecule protective agent which has a reducibility radical, in case the polymerization of the particle is carried out. As the above-mentioned macromolecule protective agent, especially if a reducibility radical is contained, it will not be limited, for example, water soluble polymers, such as polyvinyl alcohol, a polyvinyl alcohol derivative, a cellulose, cellulose acetate, starch, methyl cellulose, a carboxymethyl cellulose, hydroxyethyl cellulose, and the Pori (meta) acrylic acid (sodium salt), etc. are mentioned.

[0037] As an approach using the above-mentioned surfactant, the approach of introducing a reducibility radical into the front face of the particle obtained etc. is mentioned, for example by using the reactive surface active agent which has a reducibility radical, in case the polymerization of the particle is carried out. You may be macromolecule particles, such as not only the particle that is made to carry out the polymerization of the above reducibility radical content monomers, and is obtained as a particle which has the above-mentioned reducibility radical on a front face but benzoguanamine, nylon, polyester, protein, etc., and the particle which consists of an inorganic compound which has a reducibility radical on a front face.

[0038] The above-mentioned particle may be a coloring particle colored for the improvement in contrast of a liquid crystal display component. What was not limited especially as the above-mentioned coloring particle, for example, processed the above-mentioned particle with carbon black, a disperse dye, acid dye, basic dye, a metallic oxide, etc.; the film of the organic substance is made to form in the front face of the above-mentioned particle, and what was colored by making it decompose or carbonize at an elevated temperature is mentioned. Moreover, when the quality of the material itself which forms the above-mentioned particle has the color, it can use as the above-mentioned coloring particle as it is, without coloring.

[0039] The method of carrying out the suspension polymerization of the constituent obtained by not being limited especially as the manufacture approach of the above-mentioned coloring particle, for example, making the above-mentioned reducibility radical content monomer etc. distribute a pigment in an aqueous medium to the bottom of existence of the above-mentioned polymerization initiator etc. is mentioned.

[0040] It is not limited especially as a pigment used in case the above-mentioned coloring particle is manufactured. For example, inorganic color pigments, such as carbon black, a graphite, iron black, chrome green, cobalt green, and chromic oxide; Brilliant carmine BS Lake carmine FB, brilliant fast scarlet, Lake Red 4R, Permanent Red R, the farce tread FGR, a toluidine chestnut, Bis-azo yellow, the first yellow G, a bis-azo orange, Balkan Peninsula Orange, Azo systems and condensation azo system organic color pigments, such as pyrazolone red, A copper phthalocyanine blue, farce toss — a turnip — color lake organic color pigment; kino FUTARON

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Moreover, in addition to the above-mentioned hydroxyl group, epoxy groups, such as glycidyl (meta) acrylate, the monomer which has a carboxylic-acid radical etc. further are mentioned to give reactivity to the shell layer of the spacer for liquid crystal display components obtained. These may be used independently and may use two or more sorts together. Moreover, these polymerization nature monomer and other copolymerizable polymerization nature monomers may be used together.

[0049] As an approach of making a polymerization layer forming in the above-mentioned particle front face, the particle which has the above-mentioned reducibility radical on a front face distributes in a solvent, for example, the above-mentioned polymerization nature monomer and the above-mentioned cerium salt add to this, and the approach of carrying out a polymerization reaction etc. is mentioned to it by making the particle which has the above-mentioned reducibility radical on a front face using the above-mentioned cerium salt generate a radical, and making the above-mentioned polymerization nature monomer react further.

[0050] Although especially the reaction temperature under above-mentioned polymerization reaction is not limited, the stability of the complex of the above-mentioned cerium salt to 0-90 degrees C are desirable. It is 10-50 degrees C more preferably. Especially although not limited especially as a class of the above-mentioned solvent, since the above-mentioned cerium salt reacts with the alcohol which is a solvent and the reactivity changes especially with classes (1 and 2-glycol > the class [1st] > the class [2nd] > the 3rd class) of alcohol in using alcohol, it is suitable to use tertiary alcohol, such as t-butyl alcohol.

[0051] In order [moreover,] to speed up the reaction rate of the polymerization system of reaction when a graft polymerization reaction cannot occur easily only with the above-mentioned cerium salt or — being alike — an acid suitable in a polymerization system can be added and it can react in an acid range. It is not limited especially as the above-mentioned acid, for example, a nitric acid, a sulfuric acid, a hydrochloric acid, formic acid, etc. are mentioned. It is more suitable for six or less pH to become desirable still lower as an acid range of the polymerization system of reaction. This is because dissociation of the above-mentioned cerium salt stops being able to happen easily, when pH is high.

[0052] Moreover, further various reactions can be performed to the reaction possible part on the particle in which the polymerization layer obtained as mentioned above was formed. Although not limited especially as what is used for such a reaction, a compound with an isocyanate radical, the amino group, a carboxylic-acid radical, a carboxylate ghost, an epoxy group, a hydroxyl group, etc. can be used, for example.

[0053] This invention 2 is a spacer for liquid crystal display components which makes it come to form a reactant graft polymerization layer in the above-mentioned particle front face by making an oxidizing agent react to the particle which has a reducibility radical on a front face, making the above-mentioned particle front face generate a radical, and making the polymerization nature monomer which has an epoxy group with this radical as the starting point react.

[0054] The particle which has the reducibility radical used in this invention 2 on a front face is the same as that of the particle which has the reducibility radical explained in full detail in explanation of this invention 1 on a front face.

[0055] It is the same as that of the oxidizer explained in full detail in explanation of this invention 1 as an oxidizer used in this invention 2.

[0056] The acrylate which is not limited especially as a polymerization nature monomer which has the epoxy group used in this invention 2, for example, contains glycidyl (meta) acrylate, the glycidyl allyl compound ether, and allylic epoxy (meta) is mentioned. These may be used independently and may use two or more sorts together.

[0057] Moreover, in addition to the polymerization nature monomer which has the above-mentioned epoxy group, copolymerization of the polymerization nature monomer which has the above-mentioned epoxy group, and the monomer of copolymerizable others may be carried out. It is not limited especially as the above and other monomers. For example, styrene, alpha methyl styrene, Styrene derivatives, such as p-methyl styrene, p-chloro styrene, and chloro methyl styrene; Vinyl acetate, vinyl ester [such as propionic-acid vinyl,] — unsaturated nitrile [such as acrylonitrile]; (meta) — a methyl acrylate — An ethyl acrylate, butyl acrylate (meta), 2-

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system organic color pigments, such as the phthalocyanine system organic color pigment; yellow lake [such as a roux and Phthalocyanine Green,] Lowe's lake, Violet-Lake, blue lake, and Green lake, etc. are mentioned. These may be used independently and may use two or more sorts together.

[0041] The addition of the above-mentioned pigment has the desirable 1 ~ 180 weight section to a total of 100 weight sections of the monomer used for manufacture of the above-mentioned coloring particle. If it is hard coming to color it a dark color in case of under 1 weight section and the 180 weight sections are exceeded, the mechanical strength of the particle obtained may not be obtained. It is the 3 ~ 180 weight section more preferably.

[0042] The approach which is not limited to the above-mentioned reducibility radical content monomer etc. especially as an approach of making homogeneity distributing the above-mentioned pigment, for example, uses a ball mill, a bead mill, a sand mill, attritor, a Sand grinder, a nano mixer, etc. is mentioned.

[0043] In case the above-mentioned reducibility radical content monomer etc. is made to distribute the above-mentioned pigment, a dispersant may be added in order to raise the dispersibility of the above-mentioned pigment. It is not limited especially as the above-mentioned dispersant, for example, water soluble polymer, barium sulfates, such as polyvinyl alcohol, starch, methyl cellulose, a carboxymethyl cellulose, hydroxyethyl cellulose, and polymethacrylic acid sodium, a calcium sulfate, an aluminum sulfate, a calcium carbonate, calcium phosphate, talc, clay, the diatom earth, metallic-oxide powder, etc. are mentioned. The addition of the above-mentioned dispersant has desirable 0.01 ~ 20 weight section to a total of 100 weight sections of the monomer used for manufacture of the above-mentioned coloring particle.

[0044] A polymerization layer is made to form in the above-mentioned particle front face in this invention 1 by making an oxidizing agent react to the particle which has the above-mentioned reducibility radical on a front face, making the above-mentioned particle front face generate a radical, and making a polymerization nature monomer react with this radical as the starting point.

[0045] It is possible to oxidize the particle front face which has the above-mentioned reducibility radical on a front face as the above-mentioned oxidizing agent, and to make a radical generate, especially that is not limited, for example, persulfate, a cerium salt, a hydrogen peroxide, dimethylamine, sodium periodate, potassium permanganate, alkyl boron, etc. are mentioned. Moreover, in order to speed up the reaction rate of a polymerization system, acids and salts, such as a nitric acid, may be added.

[0046] 0.0001~20-mol% of the concentration of the above-mentioned oxidizer is desirable to the whole quantity of the monomer used for manufacture of the above-mentioned particle. If the incidence rate of the radical which becomes being less than [0.0001 mol %] with a graft polymerization start point on a particle falls and 20-mol % is exceeded, a superfluous oxidizing agent will react with the radical which carried out and generating, will make a start point disappear, and will lessen a polymerization start point.

[0047] In this invention 1, a cerium salt is suitably used as the above-mentioned oxidizer. As the above-mentioned cerium salt, especially if it is tetravalence, it will not be limited, for example, cerium (4) sulfate, a cerium nitrate, cerium (4) sulfate ammonium, pyrophosphoric-acid cerium ammonium, an iodation cerium, etc. will be mentioned.

[0048] What is necessary is not to be limited but just to use what has the engine performance to give the spacer for liquid crystal display components obtained especially, as the above-mentioned polymerization nature monomer, if it is a radical polymerization nature monomer. For example, the monomer which has hydroxyl-group; ethylene glycol components, such as hydroxyethyl (meta) acrylate and methoxy polyethylene-glycol (meta) acrylate, is mentioned to give a hydrophilic property to the spacer for liquid crystal display components obtained. Moreover, the glycidyl (meta) acrylate which has styrene derivative; reactive sites, such as fluorine content (meta) acrylate; styrene, such as alkyl (meta) acrylate; trifluoroethyl (meta) acrylate, such as butyl acrylate (meta) and acrylic-acid (meta) stearyl; and pentafluoro propyl (meta) acrylate, and p-chloro styrene, an acrylic acid (meta), acrylamide (meta), etc. can be mentioned to give hydrophobicity to the spacer for liquid crystal display components obtained.

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ethylhexyl acrylate (meta), (Meta) Ethylene glycol (meta) acrylate, trifluoroethyl (meta) acrylate, Cyclohexyl (meta) acrylate, hydroxyethyl (meta) acrylate, Acrylic ester (meta) derivatives, such as hydroxypropyl (meta) acrylate, hydroxy butyl (meta) acrylate, glycerol monochrome (meta) acrylate, and GURISERINJ (meta) acrylate, etc. are mentioned. These may be used independently and may use two or more sorts together.

[0058] Although it is not limited especially as reaction temperature of graft polymerization reaction time in case the above-mentioned reactant graft polymerization layer is made to form, the viewpoint of the viscosity of reaction time or a system to 30-100 degrees C are desirable.

[0059] Moreover, although not limited especially as a solvent of graft polymerization reaction time, the mixed stock of the water independent from a soluble viewpoint of the above-mentioned oxidizer or water, and a polar organic solvent is desirable. It is not limited especially as the above-mentioned polar organic solvent, for example, ether; dimethyl sulfoxide [such as ketones; methyl ether,], such as alcohols; acetones, such as a methanol, ethanol, propanol, i-propanol, a butanol, and t-butyl alcohol, and a methyl ethyl ketone, dimethylformamide, etc. are mentioned. These may be used independently and may use two or more sorts together.

[0060] A graft polymerization layer does not exfoliate from a particle front face, and the spacer for liquid crystal display components of this invention 2 has the high adhesion over a substrate. Therefore, liquid crystal is not polluted and the liquid crystal display component which comes to use the spacer for liquid crystal display components of this invention 2 does not have generating of the display nonuniformity by migration of a spacer etc.

[0061] This invention 3 is a spacer for liquid crystal display components characterized by making it come to form a reactant graft polymerization layer in said particle front face by making an oxidizing agent react to the particle which has a reducibility radical on a front face, making said particle front face generate a radical, and making the polymerization nature monomer which has the polymerization nature monomer and ethylene glycol radical which have an epoxy group with this radical as the starting point react.

[0062] The particle which has the reducibility radical used in this invention 3 on a front face is the same as that of the particle which has the reducibility radical explained in full detail in explanation of this invention 1 on a front face. The oxidizer used in this invention 3 is the same as the oxidizer explained in full detail in explanation of this invention 1.

[0063] The polymerization nature monomer which has the epoxy group used in this invention 3 is the same as the polymerization nature monomer which has the epoxy group explained in full detail in explanation of this invention 2. As for the polymerization nature monomer which has the ethylene glycol radical used in this invention 3, polyethylene glycol monomethacrylate, methoxy polyethylene glycol monomethacrylate, polyethylene-glycol polypropylene glycol monomethacrylate, polyethylene-glycol polytetramethylene glycol mono-methacrylate, polyethylene-glycol polypropylene-glycol mono-octanol ether methyl methacrylate, etc. are mentioned. These may be used independently and may use two or more sorts together.

[0064] Moreover, in addition to the polymerization nature monomer which has the polymerization nature monomer and ethylene glycol radical which have the above-mentioned epoxy, and the monomer of copolymerizable others may be carried out. What was illustrated as the polymerization nature monomer which is not limited especially as the above and other monomers, for example, has epoxy in explanation of this invention 2, and a monomer of copolymerizable others, the same thing, etc. are mentioned.

[0065] Although it is not limited especially as reaction temperature of graft polymerization reaction time in case the above-mentioned reactant graft polymerization layer is made to form, the viewpoint of the viscosity of reaction time or a system to 30-100 degrees C are desirable.

[0066] Moreover, although not limited especially as a solvent of graft polymerization reaction time, the mixed stock of the water independent from a soluble viewpoint of the above-mentioned oxidizer or water, and a polar organic solvent is desirable. The same thing as the polar organic solvent which it was not limited especially as the above-mentioned polar organic solvent, for example, was illustrated in explanation of this invention 2 etc. mentions, and it is ****.

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[0067] A graft polymerization layer does not exfoliate from a particle front face, and the spacer for liquid crystal display components of this invention 3 has the high adhesion over a substrate. Therefore, liquid crystal is not polluted and the liquid crystal display component which comes to use the spacer for liquid crystal display components of this invention 3 does not have generating of the display nonuniformity by migration of a spacer etc.

[0068] This invention 4 is a spacer for liquid crystal display components which makes it come to form in the above-mentioned particle front face the graft polymerization layer which has a long-chain alkyl group by making an oxidizing agent react to the particle which has a reducibility radical on a front face, making the above-mentioned particle front face generate a radical, and making the polymerization nature monomer which has a long-chain alkyl group with this radical as the starting point react.

[0069] The particle which has the reducibility radical used in this invention 4 on a front face is the same as that of the particle which has the reducibility radical explained in full detail in explanation of this invention 1 on a front face. The oxidizer used in this invention 4 is the same as the oxidizer explained in full detail in explanation of this invention 1.

[0070] Although not limited especially as a polymerization nature monomer which has the long-chain alkyl group used in this invention 4, since it excels in the effectiveness of abnormality orientation prevention, a with a carbon numbers of six or more thing is desirable. It is not limited especially as a polymerization nature monomer which has such a long-chain alkyl group. For example, neryl (meta) acrylate, octyl (meta) acrylate, iso octyl (meta) acrylate, 2-ethylhexyl (meta) acrylate, lauryl (meta) acrylate, isodecyl (meta) acrylate, tridecyl (meta) acrylate, stearyl (meta) acrylate, behenyl (meta) acrylate, cetyl (meta) acrylate, nonylphenoxylethyl (meta) acrylate, lauryl polyoxyethylene (meta) acrylate, etc. are mentioned. These may be used independently and may use two or more sorts together.

[0071] Moreover, in addition to the polymerization nature monomer which has the above-mentioned long-chain alkyl group, copolymerization of the polymerization nature monomer which has the above-mentioned long-chain alkyl group, and the monomer of copolymerizable others may be carried out. What was illustrated as the polymerization nature monomer which is not limited especially as the above and other monomers, for example, has epoxy in explanation of this invention 2, and a monomer of copolymerizable others, the same thing, etc. are mentioned.

[0072] Although it is not limited especially as reaction temperature of graft polymerization reaction time in case the graft polymerization layer which has the above-mentioned long-chain alkyl group is made to form, the viewpoint of the viscosity of reaction time or a system to 30-100 degrees C are desirable.

[0073] Moreover, although not limited especially as a solvent of graft polymerization reaction time, as a nonpolar solvent, from a soluble viewpoint of a polymerization nature monomer of having the above-mentioned oxidizer and the above-mentioned long-chain alkyl group A hexane, a heptane, an octane, benzene, toluene, etc. for example, as a polar solvent For example, water, a methanol, ethanol, propanol, i-propanol, Ether [such as ketones; methyl ether], such as alcohols; acetones, such as a butanol and t-butyl alcohol, and a methyl ethyl ketone; dimethyl sulfoxide, dimethylformamide, etc. are mentioned. These may be used independently and may use two or more sorts together.

[0074] This invention 5 is a spacer for liquid crystal display components which makes the graft-polymerization layer which has a functional group form in the above-mentioned particle front face, and makes a long-chain alkyl compound come further to react to the graft-polymerization layer which has the above-mentioned functional group by making an oxidizing agent react to the particle which has a reducibility radical on a front face, making the above-mentioned particle front face generate a radical, and making the polymerization nature monomer which has a functional group with this radical as the starting point react.

[0075] The particle which has the reducibility radical used in this invention 5 on a front face is the same as that of the particle which has the reducibility radical explained in full detail in explanation of this invention 1 on a front face. The oxidizer used in this invention 5 is the same as the oxidizer explained in full detail in explanation of this invention 1.

[0076] The polymerization nature monomer which is not limited especially as a polymerization

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explanation of this invention 1 on a front face. The oxidizer used in this invention 6 is the same as the oxidizer explained in full detail in explanation of this invention 1.

[0083] The graft polymerization layer which has a functional group in this invention 6 is the same as the graft polymerization layer which has the functional group explained in full detail in explanation of this invention 5.

[0084] In this invention 6, the active group which has a polymerization nature vinyl group and/or polymerization initiation ability is introduced into the graft polymerization layer which has the above-mentioned functional group. The method of making the compound which has the functional group in which a reaction is possible, and a polymerization nature vinyl group to the functional group of the graft polymerization layer which has the above-mentioned functional group, for example as an approach of introducing a polymerization nature vinyl group into the graft polymerization layer which has the above-mentioned functional group react to the graft polymerization layer which has the above-mentioned functional group etc. is mentioned. It is not limited especially as such a compound, for example, acryloyl (meta) acrylate, acryloyl (meta) acrylate, acryloyl (meta) isocyanate, an acrylic acid (meta), acrylic-acid (meta) chloride, acrylamide (meta), glycidyl (meta) acrylate, etc. are mentioned.

[0085] The method of making the peroxide which has the functional group in which a reaction is possible to the functional group of the graft polymerization layer which has the above-mentioned functional group, for example as an approach of introducing the active group which has polymerization initiation ability into the graft polymerization layer which has the above-mentioned functional group, an azo compound, etc. react to the graft polymerization layer which has the above-mentioned functional group etc. is mentioned. It is not limited especially as such a compound, for example, a 4 and 4-azobis-4-cyano-valeric-acid, 2, and 2-azobis-2-(2-imidazoline) propane etc. is mentioned.

[0086] After introducing the active group which has the active group and/or polymerization initiation ability which have the above-mentioned polymerization nature vinyl group into the graft polymerization layer which has the above-mentioned functional group, the polymerization nature monomer which has an epoxy group is made to react to it further in this invention 6.

[0087] The polymerization nature monomer which has the epoxy group used in this invention 6 is the same as the polymerization nature monomer which has the epoxy group explained in full detail in explanation of this invention 2.

[0088] Moreover, in addition to the polymerization nature monomer which has the above-mentioned epoxy group, copolymerization of the polymerization nature monomer which has the above-mentioned epoxy group, and the monomer of copolymerizable others may be carried out. What was illustrated as the polymerization nature monomer which is not limited especially as the above and other monomers, for example, has an epoxy group in explanation of this invention 2, and a monomer of copolymerizable others, the same thing, etc. are mentioned.

[0089] A graft polymerization layer does not exfoliate from a particle front face, and the spacer for liquid crystal display components of this invention 6 has the high adhesion over a substrate. Therefore, liquid crystal is not polluted and the liquid crystal display component which comes to use the spacer for liquid crystal display components of this invention 6 does not have generating of the display nonuniformity by migration of a spacer etc.

[0090] This invention 7 by making an oxidizing agent react to the particle which has a reducibility radical on a front face, making the above-mentioned particle front face generate a radical, and making the polymerization nature monomer which has a functional group with this radical as the starting point react. The graft polymerization layer which has a functional group is made to form in the above-mentioned particle front face. Further By making the polymerization nature monomer which has a long-chain alkyl group react to it, after introducing the active group which has a polymerization nature vinyl group and/or polymerization initiation ability into the graft polymerization layer which has the above-mentioned functional group It is the spacer for liquid crystal display components characterized by making it come to form the graft polymerization layer which has a long-chain alkyl group in the graft polymerization layer front face which has the above-mentioned functional group.

[0091] The particle which has the reducibility radical used in this invention 7 on a front face is

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nature monomer which has the functional group used in this invention 5, for example, has functional groups, such as a carbonyl group, a hydroxyl group, the amino group, an amide group, an epoxy group, a sulfone radical, a sulfinyl group, and an isocyanate radical; the vinyl monomer which generates the above functional groups with means, such as hydrolysis, addition, condensation, and ring breakage, is mentioned. It is not limited especially as such a monomer. For example, an acrylic acid (meta), 2-(meta) acryloyl (meta) succinic acid, 2-(meta) acryloyl (meta) phthalic acid, 2-hydroxyethyl (meta) acrylate, 2-hydroxypropyl (meta) acrylate, A glycerol (meta) acrylate alkylate, N-vinyl formamide, N-vinyl acetamide, acrylamide (meta), glycidyl (meta) acrylate, Gamma-methacryloxypropyl trimethoxy silane, p-sulfonic-acid styrene, 2-(acryloylamine)-An isobutane sulfonic acid, acryloyl (meta) isocyanate, Polyethylene-glycol monochrome (meta) acrylate, polypropylene-glycol monochrome (meta) acrylate, Allyl alcohol, an itaconic acid, a crotonic acid, allyl glycidyl ether, dimethylaminoethyl (meta) acrylate, dimethylaminopropyl (meta) acrylate, etc. are mentioned. These may be used independently and may use two or more sorts together. Moreover, in addition to the polymerization nature monomer which has the above-mentioned functional group, copolymerization of the polymerization nature monomer which has the above-mentioned functional group, and the monomer of copolymerizable others may be carried out.

[0077] Although it is not limited especially as reaction temperature of graft polymerization reaction time in case the graft polymerization layer which has the above-mentioned functional group is made to form, the viewpoint of the viscosity of reaction time or a system to 30-100 degrees C are desirable.

[0078] Moreover, although not limited especially as a solvent of graft polymerization reaction time, the mixed stock of the water independent from a soluble viewpoint of the above-mentioned oxidizer or water, and a polar organic solvent is desirable. The same thing as the polar organic solvent which it was not limited especially as the above-mentioned polar organic solvent, for example, was illustrated in explanation of this invention 2 etc. is mentioned.

[0079] The spacer for liquid crystal display components of this invention 5 makes a long-chain alkyl compound come further to react to the graft polymerization layer which has the above-mentioned functional group. It is not limited especially as the above-mentioned long-chain alkyl compound, for example, the halogenide and its salt, long-chain alkylamine, long-chain alkyl methoxysilane, long-chain alkyl chloride, a long-chain alkyl star's picture, long-chain glycidyl, long-chain alkyl isocyanate, etc. are mentioned to a long-chain alkyl carboxylic-acid list at the halogenide and its salt, long-chain alkyl alcohol, and a long-chain alkyl sulfonic-acid list. As for the carbon number of the alkyl group of the above-mentioned long-chain alkyl compound, 6-30 are desirable. These may be used independently and may use two or more sorts together.

[0080] Although it changes with classes of long-chain alkyl compound used as an approach of making the above-mentioned long-chain alkyl compound reacting to the graft polymerization layer which has the above-mentioned functional group, the approach of performing in organic solvents, such as a methyl ethyl ketone, a tetrahydrofuran, toluene, a xylene, and ethyl acetate, etc. is mentioned, for example. Moreover, the catalyst of an acid, alkali, etc. can be used according to the need for a reaction.

[0081] This invention 8 by making an oxidizing agent react to the particle which has a reducibility radical on a front face, making the above-mentioned particle front face generate a radical, and making the polymerization nature monomer which has a functional group with this radical as the starting point react. The graft polymerization layer which has a functional group is made to form in the above-mentioned particle front face. Further By making the polymerization nature monomer which has an epoxy group react to it, after introducing the active group which has a polymerization nature vinyl group and/or polymerization initiation ability into the graft polymerization layer which has the above-mentioned functional group It is the spacer for liquid crystal display components characterized by making it come to form the graft polymerization layer which has an epoxy group in the graft polymerization layer front face which has the above-mentioned functional group.

[0082] The particle which has the reducibility radical used in this invention 8 on a front face is the same as that of the particle which has the reducibility radical explained in full detail in

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the same as that of the particle which has the reducibility radical explained in full detail in explanation of this invention 1 on a front face. The oxidizer used in this invention 7 is the same as the oxidizer explained in full detail in explanation of this invention 1.

[0092] The graft polymerization layer which has a functional group in this invention 7 is the same as the graft polymerization layer which has the functional group explained in full detail in explanation of this invention 5.

[0093] In this invention 7, the active group which has a polymerization nature vinyl group and/or polymerization initiation ability is introduced into the graft polymerization layer which has the above-mentioned functional group. The approach of introducing a polymerization nature vinyl group into the graft polymerization layer which has the above-mentioned functional group is the same as the approach explained in full detail in explanation of the spacer for liquid crystal display components of this invention 6.

[0094] The approach of introducing the active group which has polymerization initiation ability into the graft polymerization layer which has the above-mentioned functional group is the same as the approach explained in full detail in explanation of this invention 6.

[0095] After introducing the active group which has the active group and/or polymerization initiation ability which have the above-mentioned polymerization nature vinyl group into the graft polymerization layer which has the above-mentioned functional group, the polymerization nature monomer which has a long-chain alkyl group is made to react to it further in this invention 7.

[0096] The polymerization nature monomer which has the long-chain alkyl group used in this invention 7 is the same as the polymerization nature monomer which has the long-chain alkyl group explained in full detail in explanation of this invention 4.

[0097] Moreover, in addition to the polymerization nature monomer which has the above-mentioned long-chain alkyl group, copolymerization of the polymerization nature monomer which has the above-mentioned long-chain alkyl group, and the monomer of copolymerizable others may be carried out. What was illustrated as the polymerization nature monomer which is not limited especially as the above and other monomers, for example, has an epoxy group in explanation of the spacer for liquid crystal display components of this invention 2, and a monomer of copolymerizable others, the same thing, etc. are mentioned.

[0098] Two glass substrates with which the orientation film and a transparent electrode have been arranged this invention 8 The spacer for liquid crystal display components of this invention 1, the spacer for liquid crystal display components of this invention 2, The spacer for liquid crystal display components of this invention 3, the spacer for liquid crystal display components of this invention 4, the spacer for liquid crystal display components of this invention 5, the spacer for liquid crystal display components of this invention 6, Or it is the liquid crystal display component which counters through the spacer for liquid crystal display components of this invention 7 and by which liquid crystal is enclosed between the above-mentioned glass substrates. As the above-mentioned liquid crystal display component, what was shown in drawing 1 is mentioned, for example.

[0099]

[Example] Although an example is hung up over below and this invention is explained to it in more detail, this invention is not limited only to these examples.

[0100] The mixed liquor of the divinylbenzene 100 weight section and the benzoyl-peroxide 2 weight section was added to the 3% water-solution 800 weight section of example 1 (production of the particle which has a reducibility radical on a front face) polyvinyl alcohol, it agitated with the homogenizer, and grain refining was performed. The temperature up was carried out to 80 degrees C under the nitrogen air current, agitating after that, and the reaction was performed for 15 hours. Thermion exchange water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles are mean-particle-diameter =8.0micrometer and CV value =5, and performed the next actuation by making this particle into a seed particle child.

[0101] (Production of the particle which has a polymerization layer) the seed particle child 5 weight section obtained by the separable flask by the ion-exchange-water 250 weight section, the methyl methacrylate 5 weight section, and the above-mentioned actuation --- in addition,

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after making SONIKETA distribute enough, it agitated to homogeneity. Nitrogen gas was introduced into the system and churning was continued at 30 degrees C for 3 hours. The second cerium ammonium solution of nitric acid 12.5 weight section of 0.1 mol/L adjusted in the 1-N nitric-acid water solution was added to this, and it reacted to it for 5 hours. Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. Ethanol and an acetone washed this particle enough, and the vacuum dryer performed reduced pressure drying.

[0102] Evaluation and the surface component analysis of the dynamics reinforcement of a spacer were performed by the following approach using this particle. a result — dynamics reinforcement (10% K value) — 420kg/mm² it is — Methyl methacrylate existed in the spacer front face as a result of TOF-SIMS analysis.

[0103] (Evaluation of dynamics reinforcement) the particle obtained using the minute compression test machine (PCT-200, Shimadzu Corp. make) by the cylinder smooth end face with a diameter [made from a diamond] of 50 micrometers — 0.27g /second] compression velocity and the maximum trial — too heavy — the compression test was performed by 10g and K value was calculated from the following formula.

$R-1 (K) = (3/\sqrt{0.02})$ and $F-S-3/2$ and $1/2F$: The too heavy value in 10% compression set of a particle (kg)

S: the compression in 10% compression set of a particle — a variation rate (mm)

R: The radius of a particle (mm)

[0104] (Surface component analysis) Time-of-flight mold secondary-ion-mass-spectroscopy equipment (TOF-SIMS) analyzed. According to this equipment, the rate in the polymer which constitutes the front face of each presentation from the number of counts of the mass spectrum which can analyze only the about 0.01-micrometer pole front face of the thickness direction, and is detected in the area section of 0.2-micrometer area is computable.

[0105] The same actuation as an example 1 was performed except having used the laurylacrylate 8 weight section for composition of the particle which has an example 2 polymerization layer instead of methyl methacrylate as a polymerization nature monomer. The spacer was evaluated using this particle. a result — dynamics reinforcement (10% K value) — 420kg/mm² it is — laurylacrylate existed in the spacer front face as a result of TOF-SIMS analysis.

[0106] The same actuation as an example 1 was performed except having used the hydroxy methacrylate 5 weight section for composition of the particle which has an example 3 polymerization layer instead of methyl methacrylate as a polymerization nature monomer. Hydroxyethyl methacrylate existed in the spacer front face as a result of TOF-SIMS analysis.

[0107] Furthermore, the particle 2 weight section and the toluene 30 weight section which were obtained here were stirred at 80 degrees C in the separable flask, and the Daboute rutin JIRAURI rate 0.04 weight section was dissolved in this at the toluene 4 weight section, and it added. The propyl isocyanate 5 weight section was dissolved in this at the toluene 5 weight section, and it added, and reacted at 80 degrees C for 8 hours. Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. The acetone washed this particle enough and the vacuum dryer performed reduced pressure drying.

[0108] The spacer was evaluated using this particle. a result — dynamics reinforcement (10% K value) — 420kg/mm² it is — the propyl group existed in the spacer front face as a result of TOF-SIMS analysis.

[0109] The example 4 tetramethylolethane-triacrylate 50 weight section, the divinylbenzene 20 weight section, and the acrylonitrile 20 weight section were mixed to homogeneity, the carbon black 12 weight section was added to this, and homogeneity was made to distribute carbon black over 48 hours using a bead mill. The benzoyl-peroxide 2 weight section was mixed into this monomer mixture at homogeneity, and this was further supplied to the 3% water-solution 850 weight section of polyvinyl alcohol. After agitating well and performing grain refining, the temperature up was carried out to 80 degrees C under the nitrogen air current, and the reaction was performed for 15 hours. Thermion exchange water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles are mean-particle-

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[0118] It replaced with example 7 polyvinyl alcohol, and the seed particle child was produced like the example 1 using hydroxyethyl cellulose, and the particle which has a polymerization layer like [it is the same and] an example 1 continuously was produced. The spacer was evaluated using this particle. a result — dynamics reinforcement (10% K value) — 420kg/mm² it is — methyl methacrylate existed in the spacer front face as a result of TOF-SIMS analysis.

[0119] The mixed liquor of the divinylbenzene 100 weight section and the benzoyl-peroxide 2 weight section was added to the 3% water-solution 800 weight section of example 8 (production of the particle which has a reducibility radical on a front face) polyvinyl alcohol, it agitated with the homogenizer, and grain refining was performed. The temperature up was carried out to 80 degrees C under the nitrogen air current, agitating after that, and the reaction was performed for 15 hours. Thermion exchange water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =8.0micrometer and CV value =5. When surface analysis was performed in TOF-SIMS, the OH radical of the polyvinyl alcohol origin was checked on the front face. The next actuation was performed by making this particle into a seed particle child.

[0120] (Formation of a reactant graft polymerization layer) After adding the seed particle child 5 weight section obtained by the ion-exchange-water 95 weight section, the glycidyl methacrylate 5 weight section, the methyl methacrylate 5 weight section, and the above-mentioned actuation to the separable flask and distributing it enough by SONIKETA, it agitated to homogeneity. Nitrogen gas was introduced into the system and churning was continued at 30 degrees C for 3 hours. The second cerium ammonium solution of nitric acid 10 weight section of 0.1 mol/L was added to this, and it reacted to it for 5 hours.

[0121] Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. Ethanol and an acetone washed this particle enough, and the vacuum dryer performed reduced pressure drying. About the obtained particle, the elution test and the adhesive evaluation to liquid crystal were performed by the following approach. The result was shown in Table 1.

[0122] (Elution test to liquid crystal) 0.1g of obtained particles was distributed to liquid crystal (Merck [Co.] make: ZLI-4720-000) 2mL, and it was left at 80 degrees C for 200 hours. Then, liquid crystal was collected and the gas chromatography investigated the purity of liquid crystal.

[0123] (Adhesion test) It sprinkled to the glass substrate (the Nissan chemistry company make: SANEBEA 150 230 degree-Cx 1-hour baking behind a spin coat) which the polyimide orientation film was applied [glass substrate] and stiffened the obtained particle. After heating this substrate on the temperature conditions of 150 degree-Cx 1 hour for 120 degree-Cx 10 minutes, the air blow trial was performed. The air blow trial was carried out by spraying air for 5 seconds from the distance of 10cm from a substrate from an air gun (3 kgf/cm²), and re-measuring the number of the particle which remained, after measuring the particle number within a predetermined visual field with an optical microscope.

[0124] The same actuation as example 9 (production of the particle which has a reducibility radical on a front face) example 8 was performed.

(Formation of a reactant graft polymerization layer) The same actuation as an example 8 was performed except having used hydroxyethyl methacrylate instead of methyl methacrylate. About the obtained particle, the elution test and the adhesive evaluation to liquid crystal were performed like the example 8. The result was shown in Table 1.

[0125] The same actuation as example 10 (production of the particle which has a reducibility radical on a front face) example 8 was performed.

(Formation of a reactant graft polymerization layer) The same actuation as an example 8 was performed except having used the glycidyl allyl compound ether instead of glycidyl methacrylate, and having used hydroxyethyl methacrylate instead of methyl methacrylate. About the obtained particle, the elution test and the adhesive evaluation to liquid crystal were performed like the example 8. The result was shown in Table 1.

[0126] The same actuation as example 11 (production of the particle which has a reducibility radical on a front face) example 8 was performed.

[0127] (Formation of a reactant graft polymerization layer) After adding the seed particle child 5

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diameter =8.0micrometer and CV value =5, and performed production actuation of the particle which has a polymerization layer like an example 1 by making this particle into a seed particle child.

[0110] The spacer was evaluated using this particle. a result — dynamics reinforcement (10% K value) — 420kg/mm² it is — methyl methacrylate existed in the spacer front face as a result of TOF-SIMS analysis.

[0111] The mixed liquor of the divinylbenzene 80 weight section, the hydroxyethyl methacrylate 20 weight section, and the benzoyl-peroxide 2 weight section was added to the example 5 surface-active-agent high tenor's N-08 (Dai-ichi Kogyo Seiyaku Co., Ltd. make) 3% water-solution 800 weight section, it agitated with the homogenizer, and grain refining was performed. The temperature up was carried out to 80 degrees C under the nitrogen air current, agitating after that, and the reaction was performed for 15 hours. Thermion exchange water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles are mean-particle-diameter =8.0micrometer and CV value =5, and performed production actuation of the particle which has a polymerization layer like an example 2 by making this particle into a seed particle child.

[0112] The spacer was evaluated using this particle. a result — dynamics reinforcement (10% K value) — 400kg/mm² it is — laurylacrylate existed in the spacer front face as a result of TOF-SIMS analysis.

[0113] The seed particle child 5 weight section obtained in the 10% hydrogen-peroxide-solution 60 weight section, the acetone 70 weight section, and the example 1 was put into example 8 separable flask, and it stirred for 30 minutes, and the methyl methacrylate 5 weight section and the iron-sulfate 7 hydrate 20 weight section were added to this, and it stirred at 50 degrees C for 3 hours. Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. Ethanol and an acetone washed this particle enough, and the vacuum dryer performed reduced pressure drying.

[0114] The spacer was evaluated using this particle. a result — dynamics reinforcement (10% K value) — 420kg/mm² it is — methyl methacrylate existed in the spacer front face as a result of TOF-SIMS analysis.

[0115] It replaced with example of comparison 1 polyvinyl alcohol, and the seed particle child was produced using the surfactant high tenor N-08 (Dai-ichi Kogyo Seiyaku Co., Ltd. make), and the particle which has a polymerization layer like an example 1 continuously was produced. The spacer was evaluated using this particle. a result — dynamics reinforcement (10% K value) — 420kg/mm² it is — the divinylbenzene existed in the spacer front face as a result of TOF-SIMS analysis, and existence of methyl methacrylate was not able to be checked.

[0116] After adding the seed particle child 5 weight section obtained in the ion-exchange-water 200 weight section, the methyl methacrylate 5 weight section, and the example 1 to example of comparison 2 separable flask and distributing it enough by SONIKETA, it agitated to homogeneity. Nitrogen gas was introduced into the system and churning was continued at 30 degrees C for 3 hours. Benzoyl-peroxide 0.1 weight section addition was carried out, and it reacted to this for 3 hours. Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. Ethanol and an acetone washed this particle enough, and the vacuum dryer performed reduced pressure drying. The spacer was evaluated using this particle. a result — dynamics reinforcement (10% K value) — 420kg/mm² it is — the divinylbenzene existed in the spacer front face as a result of TOF-SIMS analysis, and existence of methyl methacrylate was not able to be checked.

[0117] The same actuation as an example 1 was performed except having used the divinylbenzene 20 weight section and the laurylacrylate 80 weight section for composition of the particle which has an example of comparison 3 reducibility radical on a front face. The spacer was evaluated using this particle. And the obtained particle was very weak and dynamics reinforcement (10% K value) was not able to be measured. Laurylacrylate and a divinylbenzene existed in the spacer front face as a result of TOF-SIMS analysis.

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weight section obtained by the ion-exchange-water 100 weight section, the isopropyl alcohol 30 weight section, the glycidyl methacrylate 45 weight section, and the above-mentioned actuation to the separable flask and distributing it enough by SONIKETA, it agitated to homogeneity. Furthermore, it stirred by adding the ammonium persulfate 0.15 weight section and the sodium-hydrogensulfite 0.003 weight section, and making it fully dissolve. The system was once decompressed with the pump, nitrogen gas was introduced after that, and stirring was continued for 30 minutes. The temperature up of this was carried out to 50 degrees C, and the reaction was continued for 2 hours. The system was cooled 2 hours after, the tetrahydrofuran 100 weight section and little hydroquinone were added, and the reaction was stopped.

[0128] Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. This particle was enough washed in the tetrahydrofuran and the vacuum dryer performed reduced pressure drying. About the obtained particle, the elution test and the adhesive evaluation to liquid crystal were performed like the example 8. The result was shown in Table 1.

[0129] The example 12 (production of particle which has reducibility radical on front face) trimethylolpropane-triacrylate 50 weight section, the divinylbenzene 40 weight section, and the acrylonitrile 10 weight section were mixed to homogeneity, the carbon black 12 weight section was added to this, and stirring was performed for 48 hours using the bead mill. The benzoyl-peroxide 2 weight section was mixed into this monomer mixture at homogeneity, and this was further supplied to the 3% water-solution 850 weight section of polyvinyl alcohol. After stirring enough and performing grain refining, under the nitrogen air current, the temperature up was carried out to 80 degrees C, and the reaction was performed for 15 hours. Hot water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =8.0micrometer and CV value =5.0, and were black. When surface analysis was performed in TOF-SIMS, the OH radical of the polyvinyl alcohol origin was checked on the front face. The next actuation was performed by making this particle into a seed particle child.

[0130] (Formation of a reactant graft polymerization layer) The same actuation as an example 8 was performed. About the obtained particle, the elution test and the adhesive evaluation to liquid crystal were performed like the example 8. The result was shown in Table 1.

[0131] The mixed liquor of the divinylbenzene 80 weight section, the hydroxyethyl methacrylate 20 weight section, and the benzoyl-peroxide 2 weight section was added to the example 13 (production of particle which has reducibility radical on front face) surface-active-agent high tenor's N-08 (Dai-ichi Kogyo Seiyaku Co., Ltd. make) 3% water-solution 800 weight section, it agitated with the homogenizer, and grain refining was performed. The temperature up was carried out to 80 degrees C under the nitrogen air current, agitating after that, and the reaction was performed for 15 hours. Hot water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =8.0micrometer and CV value =5.0. When surface analysis was performed in TOF-SIMS, the OH radical of the hydroxyethyl methacrylate origin was checked on the front face. The next actuation was performed by making this particle into a seed particle child.

[0132] (Formation of a reactant graft polymerization layer) The same actuation as an example 8 was performed. About the obtained particle, the elution test and the adhesive evaluation to liquid crystal were performed like the example 8. The result was shown in Table 1.

[0133] The mixed liquor of the divinylbenzene 100 weight section and the benzoyl-peroxide 2 weight section was added to the 3% water-solution 800 weight section of example of comparison 4 polyvinyl alcohol, it agitated with the homogenizer, and grain refining was performed. The temperature up was carried out to 80 degrees C under the nitrogen air current, agitating after that, and the reaction was performed for 15 hours. Thermion exchange water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =8.0micrometer and CV value =5.0. About the obtained particle, the elution test and the adhesive evaluation to liquid crystal were performed like the example 8. The result was shown in Table 1.

[0134] 80g of particles obtained in the example 4 of example of comparison 5 comparison was

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mixed in the alcoholic solvent, and 5g of 0.2-micrometer methyl methacrylate-glycidyl methacrylate copolymerization particles was made to stick to them. This was made to cover with heat treatment and the particle which has a reaction layer was compounded. About the obtained particle, the elution test and the adhesive evaluation to liquid crystal were performed like the example 8. The result was shown in Table 1.

[0135]

Table 1

	反応層形成後の 粒子径の分布 (nm)	付着性 試験結果 (点)
実施例 9	100	9.0
実施例 10	100	9.8
実施例 11	100	9.9
実施例 12	100	9.0
実施例 13	100	8.8
比較例 4	100	3.5
比較例 5	99.5	9.0

[0136] The mixed liquor of the divinylbenzene 100 weight section and the benzoyl-peroxide 2 weight section was added to the 3% water-solution 800 weight section of example 14 (production of the particle which has a reducibility radical on a front face) polyvinyl alcohol, it agitated with the homogenizer, and grain refining was performed. The temperature up was carried out to 80 degrees C under the nitrogen air current, agitating after that, and the reaction was performed for 15 hours. Thermion exchange water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =8.0micrometer and CV value =5. When surface analysis was performed in TOF-SIMS, the OH radical of the polyvinyl alcohol origin was checked on the front face. The next actuation was performed by making this particle into a seed particle child.

[0137] (Formation of a reactant graft polymerization layer) the seed particle child 5 weight section obtained by the separable flask by the ion-exchange-water 95 weight section, the glycidyl methacrylate 5 weight section, the methoxy polyethylene-glycol mono-methacrylate (number of ethylene glycol units = 9) (Nippon Oil & Fats make-MA-400) 5 weight section, and the above-mentioned actuation — in addition, after making SONIKETA distribute enough, it agitated to homogeneity. Nitrogen gas was introduced into the system and churning was continued at 30 degrees C for 3 hours. The second cerium ammonium solution of nitric acid 10 weight section of 0.1 mol/L was added to this, and it reacted to it for 5 hours.

[0138] Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. Ethanol and an acetone washed this particle enough, and the vacuum dryer performed reduced pressure drying. About the obtained particle, dynamics reinforcement was evaluated like the example 1, and the elution test and the adhesive evaluation to liquid crystal were performed like the example 8. The result was shown in Table 2.

[0139] The same actuation as example 15 (production of the particle which has a reducibility radical on a front face) example 14 was performed.

[0140] (Formation of a reactant graft polymerization layer) The same actuation as an example 14 was performed except having used methoxy polyethylene-glycol mono-methacrylate (the number of ethylene glycol units = 9) (Nippon Oil & Fats make-MA-400) instead of methoxy polyethylene-glycol mono-methacrylate (the number of ethylene glycol units = 9) (Nippon Oil & Fats make-MA-400). About the obtained particle, dynamics reinforcement was evaluated like the example 1, and the elution test and the adhesive evaluation to liquid crystal were performed like the example 8. The result was shown in Table 2.

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[0141] The same actuation as example 16 (production of the particle which has a reducibility radical on a front face) example 14 was performed.

[0142] (Formation of a reactant graft polymerization layer) The same actuation as an example 14 was performed except having used the glycidyl allyl compound other instead of glycidyl methacrylate. About the obtained particle, dynamics reinforcement was evaluated like the example 1, and the elution test and the adhesive evaluation to liquid crystal were performed like the example 8. The result was shown in Table 2.

[0143] The same actuation as example 17 (production of the particle which has a reducibility radical on a front face) example 14 was performed.

[0144] (Formation of a reactant graft polymerization layer) the seed particle child 5 weight section obtained by the separable flask by the ion-exchange-water 100 weight section, the isopropyl alcohol 30 weight section, the glycidyl methacrylate 40 weight section, the methoxy polyethylene-glycol mono-methacrylate (number of ethylene glycol units = 9) (Nippon Oil & Fats make-MA-400) 10 weight section, and the above-mentioned actuation — in addition, after making SONIKETA distribute enough, it agitated to homogeneity. Furthermore, it stirred by adding the ammonium persulfate 0.15 weight section and the sodium-hydrogensulfite 0.003 weight section, and making it fully dissolve. The system was once decompressed with the pump, nitrogen gas was introduced after that, and stirring was continued for 30 minutes. The temperature up of this was carried out to 50 degrees C, and the reaction was continued for 2 hours. The system was cooled 2 hours after, the tetrahydrofuran 100 weight section and little hydroquinone were added, and the reaction was stopped.

[0145] Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. This particle was enough washed in the tetrahydrofuran and the vacuum dryer performed reduced pressure drying. About the obtained particle, dynamics reinforcement was evaluated like the example 1, and the elution test and the adhesive evaluation to liquid crystal were performed like the example 8. The result was shown in Table 2.

[0146] The example 18 (production of particle which has reducibility radical on front face) trimethylolpropane-triacrylate 50 weight section, the divinylbenzene 40 weight section, and the acrylonitrile 10 weight section were mixed to homogeneity, the carbon black 12 weight section was added to this, and stirring was performed for 48 hours using the bead mill. The benzoyl-peroxide 2 weight section was mixed into this monomer mixture at homogeneity, and this was further supplied to the 3% water-solution 850 weight section of polyvinyl alcohol. After stirring enough and performing grain refining, under the nitrogen air current, the temperature up was carried out to 80 degrees C, and the reaction was performed for 15 hours. Hot water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =8.0micrometer and CV value =5.0, and were black. When surface analysis was performed in TOF-SIMS, the OH radical of the polyvinyl alcohol origin was checked on the front face. The next actuation was performed by making this particle into a seed particle child.

[0147] (Formation of a reactant graft polymerization layer) The same actuation as an example 14 was performed. About the obtained particle, dynamics reinforcement was evaluated like the example 1, and the elution test and the adhesive evaluation to liquid crystal were performed like the example 8. The result was shown in Table 2.

[0148] The mixed liquor of the divinylbenzene 80 weight section, the hydroxyethyl methacrylate 20 weight section, and the benzoyl-peroxide 2 weight section was added to the example 19 (production of particle which has reducibility radical on front face) surface-active-agent high tenor's N-08 (Dai-ichi Kogyo Seiyaku Co., Ltd. make) 3% water-solution 800 weight section, it agitated with the homogenizer, and grain refining was performed. The temperature up was carried out to 80 degrees C under the nitrogen air current, agitating after that, and the reaction was performed for 15 hours. Hot water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =8.0micrometer and CV value =5.0. When surface analysis was performed in TOF-SIMS, the OH radical of the hydroxyethyl methacrylate origin was checked on the front face. The next

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actuation was performed by making this particle into a seed particle child.

[0149] (Formation of a reactant graft polymerization layer) The same actuation as an example 14 was performed. About the obtained particle, dynamics reinforcement was evaluated like the example 1, and the elution test and the adhesive evaluation to liquid crystal were performed like the example 8. The result was shown in Table 2.

[0150] The mixed liquor of the divinylbenzene 100 weight section and the benzoyl-peroxide 2 weight section was added to the 3% water-solution 800 weight section of example of comparison 6 polyvinyl alcohol, it agitated with the homogenizer, and grain refining was performed. The temperature up was carried out to 80 degrees C under the nitrogen air current, agitating after that, and the reaction was performed for 15 hours. Thermion exchange water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =8.0micrometer and CV value =5.0. About the obtained particle, dynamics reinforcement was evaluated like the example 1, and the elution test and the adhesive evaluation to liquid crystal were performed like the example 8. The result was shown in Table 2.

[0151] 80g of particles obtained in the example 6 of example of comparison 7 comparison was mixed in the alcoholic solvent, and 5g of 0.2-micrometer methoxy polyethylene-glycol mono-methacrylate (number of ethylene glycol units = 9) (Nippon Oil & Fats make-MA-400)-glycidyl methacrylate copolymerization particles was made to stick to them. This was made to cover with heat treatment and the particle which has a reaction layer was compounded. About the obtained particle, dynamics reinforcement was evaluated like the example 1, and the elution test and the adhesive evaluation to liquid crystal were performed like the example 8. The result was shown in Table 2.

[0152] The mixed liquor of the glycidyl methacrylate 50 weight section, the methoxy polyethylene-glycol mono-methacrylate (number of ethylene glycol units = 9) (Nippon Oil & Fats make-MA-400) 50 weight section, and the benzoyl-peroxide 2 weight section was added to the example of comparison 8 surfactant high tenor's N-08 (Dai-ichi Kogyo Seiyaku Co., Ltd. make) 3% water-solution 800 weight section, it agitated with the homogenizer, and grain refining was performed. The temperature up was carried out to 80 degrees C under the nitrogen air current, agitating after that, and the reaction was performed for 15 hours. Hot water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =8.0micrometer and CV value =5.0. About the obtained particle, dynamics reinforcement was evaluated like the example 1, and the elution test and the adhesive evaluation to liquid crystal were performed like the example 8. The result was shown in Table 2.

[0153]

Table 2

	平均粒径 (nm)	反応層形成後の 粒子径の分布 (nm)	付着性 試験結果 (点)
実施例 14	45.0	100	9.0
実施例 15	45.0	100	9.8
実施例 16	45.0	100	8.5
実施例 17	45.0	100	9.0
実施例 18	45.0	100	9.3
実施例 19	45.0	100	9.0
比較例 6	45.0	100	3.5
比較例 7	45.0	99.5	9.0
比較例 8	決定時に従う	100	9.0

[0154] The mixed liquor of the divinylbenzene 100 weight section and the benzoyl-peroxide 2 weight section was added to the 3% water-solution 800 weight section of example 20 (production of the particle which has a reducibility radical) polyvinyl alcohol, it agitated with the homogenizer,

and grain refining was performed. The temperature up was carried out to 80 degrees C under the nitrogen air current, agitating after that, and the reaction was performed for 15 hours. Thermion exchange water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =8.0micrometer and CV value =5. When surface analysis was performed in TOF-SIMS, the OH radical of the polyvinyl alcohol origin was checked on the front face. The next actuation was performed by making this particle into a seed particle child.

[0155] (Formation of the graft polymerization layer which has a long-chain allyl group) the seed particle child 5 weight section obtained by the separable flask by the ion-exchange-water 95 weight section, the laurylacrylate 10 weight section, and the above-mentioned actuation — in addition, after making SONIKETA distribute enough, it agitated to homogeneity. Nitrogen gas was introduced into the system and churning was continued at 30 degrees C for 3 hours. The second cerium ammonium solution of nitric acid 10 weight section of 0.1 mol/L adjusted in the 1-N nitric-acid water solution was added to this, and it reacted to it for 5 hours.

[0156] Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. Ethanol and an acetone washed this particle enough, and the vacuum dryer performed reduced pressure drying. About the obtained particle, dynamics reinforcement was evaluated like the example 1, and the orientation condition was evaluated by the following approach. The result was shown in Table 3.

[0157] (Evaluation of an orientation condition) The obtained particle was sprinkled, the substrate size 1 of 50x50mm and cel gap 0.0micrometer STN mold liquid crystal display was produced, it is the following, and the orientation condition of liquid crystal was made and evaluated. The observation comparison of the initial state (condition impressed to equipment AC3V after cel production) and electrical-potential-difference impression condition (condition which increased the electrical potential difference of 400Hz and AC50V for 5 seconds, and impressed it to equipment AC3V after that) of a liquid crystal display was carried out with the polarization microscope, and when it shone around a particle and an omission occurred after electrical-potential-difference impression, it was estimated as abnormally orientation generating.

[0158] The same actuation as example 21 (production of the particle which has a reducibility radical on a front face) example 20 was performed.

(Formation of the graft polymerization layer which has a long-chain allyl group) The same actuation as an example 20 was performed except having used octyl methacrylate instead of laurylacrylate. It evaluated about dynamics reinforcement and an orientation condition as well as [particle / which was obtained] an example 20. The result was shown in Table 3.

[0159] The same actuation as example 22 (production of the particle which has a reducibility radical on a front face) example 20 was performed.

[0160] (Formation of the graft polymerization layer which has a long-chain allyl group) the seed particle child 5 weight section obtained by the separable flask by the ion-exchange-water 50 weight section, the isopropyl alcohol 80 weight section, the stearyl methacrylate 45 weight section, and the above-mentioned actuation — in addition, after making SONIKETA distribute enough, it agitated to homogeneity. Furthermore, it stirred by adding the ammonium persulfate 0.15 weight section and the sodium-hydrogensulfite 0.003 weight section, and making it fully dissolve. The system was once decompressed with the pump, nitrogen gas was introduced after that, and stirring was continued for 30 minutes. The temperature up of this was carried out to 50 degrees C, and the reaction was continued for 2 hours. The system was cooled 2 hours after, the tetrahydrofuran 100 weight section and little hydroquinone were added, and the reaction was stopped.

[0161] Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. This particle was enough washed in the tetrahydrofuran and the vacuum dryer performed reduced pressure drying. It evaluated about dynamics reinforcement and an orientation condition as well as [particle / which was obtained] an example 20. The result was shown in Table 3.

[0162] The example 23 (production of particle which has reducibility radical on front face)

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trimethylolpropane-triacrylate 50 weight section, the divinylbenzene 40 weight section, and the acrylonitrile 10 weight section were mixed to homogeneity, the carbon black 12 weight section was added to this, and stirring was performed for 48 hours using the bead mill. The benzoyl-peroxide 2 weight section was mixed into this monomer mixture at homogeneity, and this was further supplied to the 3% water-solution 850 weight section of polyvinyl alcohol. After stirring enough and performing grain refining, under the nitrogen air current, the temperature up was carried out to 80 degrees C, and the reaction was performed for 15 hours. Hot water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =8.0micrometer and CV value =5.0, and were black. When surface analysis was performed in TOF-SIMS, the OH radical of the polyvinyl alcohol origin was checked on the front face. The next actuation was performed by making this particle into a seed particle child.

[0183] (Formation of the graft polymerization layer which has a long-chain alkyl group) The same actuation as an example 20 was performed. It evaluated about dynamics reinforcement and an orientation condition as well as [particle / which was obtained] an example 20. The result was shown in Table 3.

[0184] The mixed liquor of the divinylbenzene 80 weight section, the hydroxyethyl methacrylate 20 weight section, and the benzoyl-peroxide 2 weight section was added to the example 24 (production of particle which has reducibility radical on front face) surface-active-agent high tenor's N-08 (Dai-ichi Kogyo Seiyaku Co., Ltd. make) 3% water-solution 800 weight section, it agitated with the homogenizer, and grain refining was performed. The temperature up was carried out to 80 degrees C under the nitrogen air current, agitating after that, and the reaction was performed for 15 hours. Hot water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =8.0micrometer and CV value =5.0. When surface analysis was performed in TOF-SIMS, the OH radical of the hydroxyethyl methacrylate origin was checked on the front face. The next actuation was performed by making this particle into a seed particle child.

[0185] (Formation of the graft polymerization layer which has a long-chain alkyl group) The same actuation as an example 20 was performed. It evaluated about dynamics reinforcement and an orientation condition as well as [particle / which was obtained] an example 20. The result was shown in Table 3.

[0186] The mixed liquor of the divinylbenzene 100 weight section and the benzoyl-peroxide 2 weight section was added to the 3% water-solution 800 weight section of example of comparison 9 polyvinyl alcohol, it agitated with the homogenizer, and grain refining was performed. The temperature up was carried out to 80 degrees C under the nitrogen air current, agitating after that, and the reaction was performed for 15 hours. Thermion exchange water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =8.0micrometer and CV value =5. It evaluated about dynamics reinforcement and an orientation condition as well as [particle / which was obtained] an example 20. The result was shown in Table 3.

[0187] The mixed liquor of the divinylbenzene 20 weight section, the stearyl methacrylate 80 weight section, and the benzoyl-peroxide 2 weight section was added to the example of comparison 10 surface-active-agent high tenor's N-08 (Dai-ichi Kogyo Seiyaku Co., Ltd. make) 3% water-solution 800 weight section, it stirred with the homogenizer, and grain refining was performed. The temperature up was carried out to 80 degrees C under the nitrogen air current, agitating after that, and the reaction was performed for 15 hours. Thermion exchange water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =8.0micrometer and CV value =5. It evaluated about dynamics reinforcement and an orientation condition as well as [particle / which was obtained] an example 20. The result was shown in Table 3.

[0188] The same actuation as example of comparison 11 (production of the particle which has a reducibility radical on a front face) example 20 was performed.

(Formation of a graft polymerization layer) The same actuation as an example 20 was performed except having used the methyl methacrylate 10 weight section instead of laurylacrylate. It

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evaluated about dynamics reinforcement and an orientation condition as well as [particle / which was obtained] an example 20. The result was shown in Table 3.

[0189]

[Table 3]

	力学強度 (K10値)	実用性試験評価
実施例 20	4.0	異相配向発生せず
実施例 21	4.0	粒子の1層に異相配向発生
実施例 22	4.0	異相配向発生せず
実施例 23	4.0	異相配向発生せず
実施例 24	4.0	異相配向発生せず
比較例 9	4.0	粒子全周に異相配向発生
比較例 10	異相配向に優出	異相配向発生せず
比較例 11	4.0	粒子全周に異相配向発生

[0170] The mixed liquor of the divinylbenzene 100 weight section and the benzoyl-peroxide 2 weight section was added to the 3% water-solution 800 weight section of example 25 (production of the particle which has a reducibility radical on a front face) polyvinyl alcohol, it agitated with the homogenizer, and grain refining was performed. The temperature up was carried out to 80 degrees C under the nitrogen air current, agitating after that, and the reaction was performed for 15 hours. Thermion exchange water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =8.0micrometer and CV value =5. When surface analysis was performed in TOF-SIMS, the OH radical of the polyvinyl alcohol origin was checked on the front face. The next actuation was performed by making this particle into a seed particle child.

[0171] (Formation of the graft polymerization layer which has a functional group) the seed particle child 5 weight section obtained by the separable flask by the ion-exchange-water 95 weight section, the hydroxyethyl methacrylate 10 weight section, and the above-mentioned actuation — in addition, after making SONIKETA distribute enough, it agitated to homogeneity. Nitrogen gas was introduced into the system and churning was continued at 30 degrees C for 3 hours. The second cerium ammonium solution of nitric acid 10 weight section of 0.1 mola / L, adjusted in the 1-N nitric-acid water solution was added to this, and it reacted to it for 5 hours. Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. Ethanol and an acetone washed this particle enough, and the vacuum dryer performed reduced pressure drying.

[0172] (Reaction of a long-chain alkyl compound) the particle 5 weight section obtained by the toluene 80 weight section and the above-mentioned actuation by the separable flask — in addition, after making SONIKETA distribute enough, it stirred to homogeneity. Subsequently, after adding the JIRAURIN acid d-m-butyl tin 0.05 weight section and stirring enough, the solution which melted the stearyl isocyanate 5 weight section in the toluene 10 weight section was dropped. The temperature up of the system was carried out to 80 degrees C, and the reaction was continued for 5 hours.

[0173] Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. Toluene and an acetone washed this particle enough, and the vacuum dryer performed reduced pressure drying. About the obtained particle, dynamics reinforcement was evaluated like the example 1, and the orientation condition was evaluated like the example 20. The result was shown in Table 4.

[0174] The same actuation as example 26 (production of the particle which has a reducibility radical on a front face) example 25 was performed.

(Formation of the graft polymerization layer which has a functional group) The same actuation as

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an example 25 was performed.

[0175] (Reaction of a long-chain alkyl compound) the particle 5 weight section obtained by the separable flask by the tetrahydrofuran 150 weight section, the triethylamine 20 weight section, and the above-mentioned actuation — in addition, after making SONIKETA distribute enough, it stirred to homogeneity. Subsequently, the solution which melted the stearin acid chloride 10 weight section in the tetrahydrofuran 20 weight section was dropped at the system. The system was kept at 30 degrees C, it stirred for 3 hours, and the reaction was continued.

[0176] Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. The tetrahydrofuran and the methanol washed this particle enough, and the vacuum dryer performed reduced pressure drying. It evaluated about dynamics reinforcement and an orientation condition as well as [particle / which was obtained] an example 25.

[0177] The same actuation as example 27 (production of the particle which has a reducibility radical on a front face) example 25 was performed.

(Formation of the graft polymerization layer which has a functional group) The same actuation as an example 25 was performed except having used the methacrylic-acid 10 weight section instead of hydroxyethyl methacrylate.

[0178] (Reaction of a long-chain alkyl compound) the particle 10 weight section obtained by the separable flask by the toluene 60 weight section, the triethylamine 1 weight section, and the above-mentioned actuation — in addition, after making SONIKETA distribute enough, it stirred to homogeneity. Subsequently, the solution which melted the stearyl glycidyl 10 weight section in the toluene 10 weight section was dropped at the system. The system was stirred under reflux temperature for 6 hours, and the reaction was continued.

[0179] Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. Toluene and a methanol washed this particle enough, and the vacuum dryer performed reduced pressure drying. It evaluated about dynamics reinforcement and an orientation condition as well as [particle / which was obtained] an example 25. The result was shown in Table 4.

[0180] The same actuation as example 28 (production of the particle which has a reducibility radical on a front face) example 25 was performed.

[0181] (Formation of the graft polymerization layer which has a functional group) the seed particle child 5 weight section obtained by the separable flask by the ion-exchange-water 100 weight section, the isopropyl alcohol 30 weight section, the glycidyl methacrylate 45 weight section, and the above-mentioned actuation — in addition, after making SONIKETA distribute enough, it agitated to homogeneity. Furthermore, it stirred by adding the ammonium persulfate 0.15 weight section and the sodium-hydrogensulfate 0.003 weight section, and making it dissolve enough. The system was once decompressed with the pump, nitrogen gas was introduced after that, and stirring was continued for 30 minutes. The temperature up of this was carried out to 50 degrees C, and the reaction was continued for 2 hours. The system was cooled 2 hours after, the tetrahydrofuran 100 weight section and little hydroquinone were added, and the reaction was stopped.

[0182] Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. This particle was enough washed in the tetrahydrofuran and the vacuum dryer performed reduced pressure drying.

[0183] (Reaction of a long-chain alkyl compound) the particle 10 weight section obtained by the separable flask by the toluene 60 weight section, the triethylamine 1 weight section, and the above-mentioned actuation — in addition, after making SONIKETA distribute enough, it stirred to homogeneity. Subsequently, the solution which melted the stearyl amine 10 weight section in the toluene 10 weight section was dropped at the system. The system was stirred under reflux temperature for 6 hours, and the reaction was continued.

[0184] Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. Toluene and a methanol washed this particle enough, and the vacuum dryer performed reduced pressure

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drying. It evaluated about dynamics reinforcement and an orientation condition as well as [particle / which was obtained] an example 25. The result was shown in Table 4.

[0185] The example 29 (production of particle which has reducibility radical on front face) trimethylolpropane-triacrylate 50 weight section, the divinylbenzene 40 weight section, and the acrylonitrile 10 weight section were mixed to homogeneity, the carbon black 12 weight section was added to this, and stirring was performed for 48 hours using the bead mill. The benzoyl-peroxide 2 weight section was mixed into this monomer mixture at homogeneity, and this was further supplied to the 3% water-solution 850 weight section of polyvinyl alcohol. After stirring enough and performing grain refining, under the nitrogen air current, the temperature up was carried out to 80 degrees C, and the reaction was performed for 15 hours. Hot water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =8.0micrometer and CV value =5.0, and were black. When surface analysis was performed in TOF-SIMS, the OH radical of the polyvinyl alcohol origin was checked on the front face. The next actuation was performed by making this particle into a seed particle child.

[0186] (Formation of the graft polymerization layer which has a functional group) The same actuation as an example 25 was performed.

(Reaction of a long-chain alkyl compound) The same actuation as an example 25 was performed. It evaluated about dynamics reinforcement and an orientation condition as well as [particle / which was obtained] an example 25. The result was shown in Table 4.

[0187] The mixed liquor of the divinylbenzene 80 weight section, the hydroxyethyl methacrylate 20 weight section, and the benzoyl-peroxide 2 weight section was added to the example 30 (production of particle which has reducibility radical on front face) surface-active-agent high tenor's N-08 (Dai-ichi Kogyo Seiyaku Co., Ltd. make) 3% water-solution 800 weight section, it agitated with the homogenizer, and grain refining was performed. The temperature up was carried out to 80 degrees C under the nitrogen air current, agitating after that, and the reaction was performed for 15 hours. Hot water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =8.0micrometer and CV value =5.0. When surface analysis was performed in TOF-SIMS, the OH radical of the hydroxyethyl methacrylate origin was checked on the front face. The next actuation was performed by making this particle into a seed particle child.

[0188] (Formation of the graft polymerization layer which has a functional group) The same actuation as an example 25 was performed.

(Reaction of a long-chain alkyl compound) The same actuation as an example 25 was performed. It evaluated about dynamics reinforcement and an orientation condition as well as [particle / which was obtained] an example 25. The result was shown in Table 4.

[0189] The same actuation as an example 25 was performed except having used hydroxypropylcellulose instead of example 31 (production of the particle which has a reducibility radical on a front face) polyvinyl alcohol. When surface analysis was performed in TOF-SIMS, the OH radical of the hydroxypropylcellulose origin was checked on the front face. The next actuation was performed by making this particle into a seed particle child.

[0190] (Formation of the graft polymerization layer which has a functional group) The same actuation as an example 25 was performed.

(Reaction of a long-chain alkyl compound) The same actuation as an example 25 was performed. It evaluated about dynamics reinforcement and an orientation condition as well as [particle / which was obtained] an example 25. The result was shown in Table 4.

[0191] The same actuation as example of comparison 12 (production of the particle which has a reducibility radical on a front face) example 25 was performed.

(Formation of a graft polymerization layer) The same actuation as an example 25 was performed except having used propyl acid chloride instead of stearin acid chloride. It evaluated about dynamics reinforcement and an orientation condition as well as [particle / which was obtained] an example 25. The result was shown in Table 4.

[0192]

[Table 4]

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	分子構造 (K10値)	実施例の名称
実施例 2-5	4.50	高減圧乾燥セシ
実施例 2-6	4.50	高減圧乾燥セシ
実施例 2-7	4.50	高減圧乾燥セシ
実施例 2-8	4.50	高減圧乾燥セシ
実施例 2-9	4.00	高減圧乾燥セシ
実施例 3-0	4.30	高減圧乾燥セシ
実施例 3-1	4.50	高減圧乾燥セシ
実施例 1-2	4.50	高減圧乾燥セシ

[0193] The mixed liquor of the divinylbenzene 100 weight section and the benzoyl-peroxide 2 weight section was added to the 3% water-solution 800 weight section of example 32 (production of the particle which has a reducibility radical on a front face) polyvinyl alcohol, it agitated with the homogenizer, and grain refining was performed. The temperature up was carried out to 80 degrees C under the nitrogen air current, agitating after that, and the reaction was performed for 15 hours. Thermion exchange water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =6.0micrometer and CV value =5. When surface analysis was performed in TOF-SIMS, the OH radical of the polyvinyl alcohol origin was checked on the front face. The next actuation was performed by making this particle into a seed particle child.

[0194] (Formation of the graft polymerization layer which has a functional group) the seed particle child 5 weight section obtained by the separable flask by the ion-exchange-water 95 weight section, the hydroxyethyl methacrylate 10 weight section, and the above-mentioned actuation — in addition, after making SONIKETA distribute enough, it agitated to homogeneity. Nitrogen gas was introduced into the system and churning was continued at 30 degrees C for 3 hours. The second cerium ammonium solution of nitric acid 10 weight section of 0.1 mola / L, adjusted in the 1-N nitric-acid water solution was added to this, and it reacted to it for 5 hours. Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. Ethanol and an acetone washed this particle enough, and the vacuum dryer performed reduced pressure drying.

[0195] (Installation of a polymerization nature vinyl group) the particle 5 weight section obtained by the toluene 100 weight section and the above-mentioned actuation by the separable flask — in addition, after making SONIKETA distribute enough, it stirred to homogeneity. Furthermore, the JIRAURN acid di-n-butyl tin 0.05 weight section diluted with the toluene 10 weight section was added, and it stirred enough. The methacryloyl ethyl isocyanate 5 weight section diluted with the toluene 10 weight section was dropped here, the temperature up of the system was carried out to 80 degrees C after dropping termination, and the reaction was continued for 5 hours. Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. Ethanol and an acetone washed this particle enough, and the vacuum dryer performed reduced pressure drying.

[0196] (Formation of the graft polymerization layer which has an epoxy group) the particle 5 weight section obtained by the separable flask by the toluene 50 weight section, the glycidyl methacrylate 50 weight section, and the above-mentioned actuation — in addition, after making SONIKETA distribute enough, it stirred to homogeneity. Nitrogen gas was introduced into the system and stirring was continued at 30 degrees C for 1 hour. Subsequently, the temperature up of the system was carried out to 60 degrees C, and the benzoyl-peroxide 0.1 weight section melted in the toluene 10 weight section was dropped. After continuing a reaction for 4 hours, the benzoyl-peroxide 0.1 weight section further melted in the toluene 10 weight section was dropped, and the reaction was continued for 4 hours. Reaction mixture was taken out after reaction termination, and after collecting the homopolymers which have separated with toluene,

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the tetrahydrofuran 100 weight section and little hydroquinone were added, and the reaction was stopped. Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. This particle was enough washed in the tetrahydrofuran and the vacuum dryer performed reduced pressure drying.

[0202] (Installation of a polymerization nature vinyl group) the particle 5 weight section obtained by the toluene 80 weight section and the above-mentioned actuation by the separable flask — in addition, after making SONIKETA distribute enough, it stirred to homogeneity. Furthermore, the methacrylic-acid 5 weight section diluted with the toluene 10 weight section was added, and it stirred enough. Subsequently, the temperature up of the system was carried out to 80 degrees C, and the reaction was continued for 5 hours. Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. Ethanol and an acetone washed this particle enough, and the vacuum dryer performed reduced pressure drying.

[0203] (Formation of the graft polymerization layer which has an epoxy group) The same actuation as an example 32 was performed. About the obtained particle, dynamics reinforcement was evaluated like the example 1, and a liquid crystal elution test and adhesive evaluation were performed like the example 8. The result was shown in Table 5.

[0204] The example 38 (production of particle which has reducibility radical on front face) trimethylolpropane-triacrylate 50 weight section, the divinylbenzene 40 weight section, and the acrylonitrile 10 weight section were mixed to homogeneity, the carbon black 12 weight section was added to this, and stirring was performed for 48 hours using the bead mill. The benzoyl-peroxide 2 weight section was mixed into this monomer mixture at homogeneity, and this was further supplied to the 3% water-solution 850 weight section of polyvinyl alcohol. After stirring enough and performing grain refining, under the nitrogen air current, the temperature up was carried out to 80 degrees C, and the reaction was performed for 15 hours. Hot water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =8.0micrometer and CV value =5.0, and were black. When surface analysis was performed in TOF-SIMS, the OH radical of the polyvinyl alcohol origin was checked on the front face. The next actuation was performed by making this particle into a seed particle child.

[0205] (Formation of the graft polymerization layer which has a functional group) The same actuation as an example 32 was performed.

(Installation of a polymerization nature vinyl group) The same actuation as an example 32 was performed.

(Formation of the graft polymerization layer which has an epoxy group) The same actuation as an example 32 was performed. About the obtained particle, dynamics reinforcement was evaluated like the example 1, and a liquid crystal elution test and adhesive evaluation were performed like the example 8. The result was shown in Table 5.

[0206] The mixed liquor of the divinylbenzene 80 weight section, the hydroxyethyl methacrylate 20 weight section, and the benzoyl-peroxide 2 weight section was added to the example 37 (production of particle which has reducibility radical on front face) surface-active-agent high tenor's N-08 (Dai-ichi Kogyo Seiyaku Co., Ltd. make) 3% water-solution 800 weight section, it agitated with the homogenizer, and grain refining was performed. The temperature up was carried out to 80 degrees C under the nitrogen air current, agitating after that, and the reaction was performed for 15 hours. Hot water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =6.0micrometer and CV value =5.0. When surface analysis was performed in TOF-SIMS, the OH radical of the hydroxyethyl methacrylate origin was checked on the front face. The next actuation was performed by making this particle into a seed particle child.

[0207] (Formation of the graft polymerization layer which has a functional group) The same actuation as an example 32 was performed.

(Installation of a polymerization nature vinyl group) The same actuation as an example 32 was performed.

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a particle and toluene were carried out the ** exception with the 3-micrometer membrane filter. Toluene and an acetone washed this particle enough, and the vacuum dryer performed reduced pressure drying. About the obtained particle, dynamics reinforcement was evaluated like the example 1, and a liquid crystal elution test and adhesive evaluation were performed like the example 8. The result was shown in Table 5.

[0197] The same actuation as example 33 (production of the particle which has a reducibility radical on a front face) example 32 was performed.

(Formation of the graft polymerization layer which has a functional group) The same actuation as an example 32 was performed.

(Installation of a polymerization nature vinyl group) The same actuation as an example 32 was performed.

(Formation of the graft polymerization layer which has an epoxy group) Instead of the glycidyl methacrylate 50 weight section, the same actuation as an example 32 was performed except having considered as the glycidyl methacrylate 30 weight section and the methyl methacrylate 20 weight section. About the obtained particle, dynamics reinforcement was evaluated like the example 1, and a liquid crystal elution test and adhesive evaluation were performed like the example 8. The result was shown in Table 5.

[0198] The same actuation as example 34 (production of the particle which has a reducibility radical on a front face) example 32 was performed.

(Formation of the graft polymerization layer which has a functional group) The same actuation as an example 32 was performed.

(Installation of the active group which has polymerization initiation ability) the particle 5 weight section obtained by the separable flask by the dimethylformamide 30 weight section, the triethylamine 5 weight section, and the above-mentioned actuation — in addition, after making SONIKETA distribute enough, it stirred to homogeneity. The 4 and 4-azobis-4-cyano valeric-acid chloride 5 weight section dissolved in the dimethylformamide 10 weight section was dropped at this. After continuing a reaction for 4 hours, reaction mixture was taken out and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. Dimethylformamide, the methanol, and the acetone washed this particle enough, and the vacuum dryer performed reduced pressure drying.

(Formation of the graft polymerization layer which has an epoxy group) the particle 5 weight section obtained by the separable flask by the toluene 50 weight section, the glycidyl methacrylate 30 weight section, the methyl methacrylate 20 weight section, and the above-mentioned actuation — in addition, after making SONIKETA distribute enough, it stirred to homogeneity. Nitrogen gas was introduced into the system and stirring was continued at 30 degrees C for 1 hour. Subsequently, the temperature up of the system was carried out to 70 degrees C, and the reaction was continued for 7 hours.

[0199] Reaction mixture was taken out after reaction termination, and after collecting the homopolymers which have separated with toluene, a particle and toluene were carried out the ** exception with the 3-micrometer membrane filter. Toluene and an acetone washed this particle enough, and the vacuum dryer performed reduced pressure drying. About the obtained particle, dynamics reinforcement was evaluated like the example 1, and a liquid crystal elution test and adhesive evaluation were performed like the example 8. The result was shown in Table 5.

[0200] The same actuation as example 35 (production of the particle which has a reducibility radical on a front face) example 32 was performed.

[0201] (Formation of the graft polymerization layer which has a functional group) the seed particle child 5 weight section obtained by the separable flask by the ion-exchange-water 100 weight section, the isopropyl alcohol 30 weight section, the glycidyl methacrylate 45 weight section, and the above-mentioned actuation — in addition, after making SONIKETA distribute enough, it agitated to homogeneity. Furthermore, by adding the ammonium persulfate 0.15 weight section and the sodium-hydrogencarbonate 0.003 weight section, and making it dissolve enough. A system is once decompressed with a pump, nitrogen gas is introduced after that, and it is 30-minute stirring *****. The temperature up of this was carried out to 50 degrees C, and the reaction was continued for 2 hours. The system was cooled 2 hours after,

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(Formation of the graft polymerization layer which has an epoxy group) The same actuation as an example 32 was performed. About the obtained particle, dynamics reinforcement was evaluated like the example 1, and a liquid crystal elution test and adhesive evaluation were performed like the example 8. The result was shown in Table 5.

[0208] The mixed liquor of the divinylbenzene 100 weight section and the benzoyl-peroxide 2 weight section was added to the 3% water-solution 800 weight section of example of comparison 13 polyvinyl alcohol, it agitated with the homogenizer, and grain refining was performed. The temperature up was carried out to 80 degrees C under the nitrogen air current, agitating after that, and the reaction was performed for 15 hours. Thermion exchange water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =8.0micrometer and CV value =5. About the obtained particle, dynamics reinforcement was evaluated like the example 1, and a liquid crystal elution test and adhesive evaluation were performed like the example 8. The result was shown in Table 5.

[0209] 80g of particles obtained in the example 13 of example of comparison 14 comparison was mixed in the alcoholic solvent, and 5g of 0.2-micrometer methyl methacrylate-glycidyl methacrylate copolymerization particles was made to stick to them. This was made to cover with heat treatment and the particle which has a reaction layer was compounded. About the obtained particle, dynamics reinforcement was evaluated like the example 1, and a liquid crystal elution test and adhesive evaluation were performed like the example 8. The result was shown in Table 5.

[0210] The mixed liquor of the divinylbenzene 20 weight section, the hydroxyethyl methacrylate 80 weight section, and the benzoyl-peroxide 2 weight section was added to the example of comparison 15 surface-active-agent high tenor's N-08 (Dai-ichi Kogyo Seiyaku Co., Ltd. make) 3% water-solution 800 weight section, it agitated with the homogenizer, and grain refining was performed. The temperature up was carried out to 80 degrees C under the nitrogen air current, agitating after that, and the reaction was performed for 15 hours. Hot water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =8.0micrometer and CV value =5.0. When surface analysis was performed in TOF-SIMS, the OH radical of the hydroxyethyl methacrylate origin was checked on the front face. About the obtained particle, dynamics reinforcement was evaluated like the example 1, and a liquid crystal elution test and adhesive evaluation were performed like the example 8. The result was shown in Table 5.

[0211] The same actuation as example of comparison 16 (production of the particle which has a reducibility radical on a front face) example 32 was performed.

(Formation of the graft polymerization layer which has a functional group) The same actuation as an example 32 was performed.

(Installation of a polymerization nature vinyl group) The same actuation as an example 32 was performed.

(Formation of the graft polymerization layer which has an epoxy group) Instead of glycidyl methacrylate, the same actuation as an example 32 was performed except having considered as the methyl methacrylate 50 weight section. About the obtained particle, dynamics reinforcement was evaluated like the example 1, and a liquid crystal elution test and adhesive evaluation were performed like the example 8. The result was shown in Table 5.

[0212]

[Table 5]

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	力率濃度 (K100)	反応生成物 白濁による 低減の程度 (%)	付着性 177- 反応 物質 (%)
実施例 3.2	4.50	100	9.5
実施例 3.3	4.50	100	8.6
実施例 3.4	4.50	100	8.0
実施例 3.5	4.50	100	9.3
実施例 3.6	4.00	100	9.4
実施例 3.7	4.20	100	9.6
比較例 1.3	4.50	100	3.5
比較例 1.4	4.50	99.5	8.0
比較例 1.5	測定中に故障	100	8.4
比較例 1.6	4.50	100	4.0

[0213] The mixed liquor of the divinylbenzene 100 weight section and the benzoyl-peroxide 2 weight section was added to the 3% water-solution 800 weight section of example 38 (production of the particle which has a reducibility radical on a front face) polyvinyl alcohol, it agitated with the homogenizer, and grain refining was performed. The temperature up was carried out to 80 degrees C under the nitrogen air current, agitating after that, and the reaction was performed for 15 hours. Thermion exchange water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =8.0micrometer and CV value =5. When surface analysis was performed in TOF-SIMS, the OH radical of the polyvinyl alcohol origin was checked on the front face. The next actuation was performed by making this particle into a seed particle child.

[0214] (Formation of the graft polymerization layer which has a functional group) the seed particle child 5 weight section obtained by the separable flask by the ion-exchange-water 95 weight section, the hydroxyethyl methacrylate 10 weight section, and the above-mentioned actuation — in addition, after making SONIKETA distribute enough, it agitated to homogeneity. Nitrogen gas was introduced into the system and churning was continued at 30 degrees C for 3 hours. The second cerium ammonium solution of nitric acid 10 weight section of 0.1 mola / L adjusted in the 1-N nitric-acid water solution was added to this, and it reacted to it for 5 hours. Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. Ethanol and an acetone washed this particle enough, and the vacuum dryer performed reduced pressure drying.

[0215] (Installation of a polymerization nature vinyl group) the particle 5 weight section obtained by the toluene 100 weight section and the above-mentioned actuation by the separable flask — in addition, after making SONIKETA distribute enough, it stirred to homogeneity. Furthermore, the JIRAUIN acid di-n-butyl tin 0.05 weight section diluted with the toluene 10 weight section was added, and it stirred enough. The methacryloyloxyethyl isocyanate 5 weight section diluted with the toluene 10 weight section was dropped here, the temperature up of the system was carried out to 80 degrees C after dropping termination, and the reaction was continued for 5 hours. Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. Ethanol and an acetone washed this particle enough, and the vacuum dryer performed reduced pressure drying.

[0216] (Formation of the graft polymerization layer which has a long-chain alkyl group) the particle 5 weight section obtained by the separable flask by the toluene 50 weight section, the stearyl methacrylate 50 weight section, and the above-mentioned actuation — in addition, after making SONIKETA distribute enough, it stirred to homogeneity. Nitrogen gas was introduced into the system and stirring was continued at 30 degrees C for 1 hour. Subsequently, the temperature up of the system was carried out to 60 degrees C, and the benzoyl-peroxide 0.1

weight section melted in the toluene 10 weight section was dropped. After continuing a reaction for 4 hours, the benzoyl-peroxide 0.1 weight section further melted in the toluene 10 weight section was dropped, and the reaction was continued for 4 hours.

[0217] Reaction mixture was taken out after reaction termination, and after collecting the homopolymers which have separated with toluene, a particle and toluene were carried out the ** exception with the 3-micrometer membrane filter. Toluene and an acetone washed this particle enough, and the vacuum dryer performed reduced pressure drying. About the obtained particle, dynamics reinforcement was evaluated like the example 1, and the orientation condition was evaluated like the example 20. The result was shown in Table 6.

[0218] The same actuation as example 39 (production of the particle which has a reducibility radical on a front face) example 38 was performed.

(Formation of the graft polymerization layer which has a functional group) The same actuation as an example 38 was performed.

(Installation of a polymerization nature vinyl group) The same actuation as an example 38 was performed.

[0219] (Formation of the graft polymerization layer which has a long-chain alkyl group) The same actuation as an example 38 was performed except having used the octyl methacrylate 30 weight section and the methyl methacrylate 20 weight section instead of stearyl methacrylate. About the obtained particle, evaluation of dynamics reinforcement and an orientation condition was performed like the example 38. The result was shown in Table 6.

[0220] The same actuation as example 40 (production of the particle which has a reducibility radical on a front face) example 38 was performed.

(Formation of the graft polymerization layer which has a functional group) The same actuation as an example 38 was performed.

[0221] (Installation of the active group which has polymerization initiation ability) the particle 5 weight section obtained by the separable flask by the dimethylformamide 30 weight section, the triethylamine 5 weight section, and the above-mentioned actuation — in addition, after making SONIKETA distribute enough, it stirred to homogeneity. The 4 and 4-azobis-4-cyano valeric-acid chloride 5 weight section dissolved in the dimethylformamide 10 weight section was dropped at this. After continuing a reaction for 4 hours, reaction mixture was taken out and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. Dimethylformamide, the methanol, and the acetone washed this particle enough, and the vacuum dryer performed reduced pressure drying.

[0222] (Formation of the graft polymerization layer which has a long-chain alkyl group) the particle 5 weight section obtained by the separable flask by the toluene 50 weight section, the stearyl methacrylate 50 weight section, and the above-mentioned actuation — in addition, after making SONIKETA distribute enough, it stirred to homogeneity. Nitrogen gas was introduced into the system and stirring was continued at 30 degrees C for 1 hour. Subsequently, the temperature up of the system was carried out to 70 degrees C, and the reaction was continued for 7 hours.

[0223] Reaction mixture was taken out after reaction termination, and after collecting the homopolymers which have separated with toluene, a particle and toluene were carried out the ** exception with the 3-micrometer membrane filter. Toluene and an acetone washed this particle enough, and the vacuum dryer performed reduced pressure drying. About the obtained particle, evaluation of dynamics reinforcement and an orientation condition was performed like the example 38. The result was shown in Table 6.

[0224] The same actuation as example 41 (production of the particle which has a reducibility radical on a front face) example 38 was performed.

[0225] (Formation of the graft polymerization layer which has a functional group) the seed particle child 5 weight section obtained by the separable flask by the ion-exchange-water 100 weight section, the isopropyl alcohol 30 weight section, the glycidyl methacrylate 45 weight section, and the above-mentioned actuation — in addition, after making SONIKETA distribute enough, it agitated to homogeneity. Furthermore, it stirred by adding the ammonium persulfate 0.15 weight section and the sodium-hydrogencarbonate 0.003 weight section, and making it

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dissolve enough. A system is once decompressed with a pump, nitrogen gas is introduced after that, and it is 30-minute stirring *****. The temperature up of this was carried out to 50 degrees C, and the reaction was continued for 2 hours. The system was cooled 2 hours after, the tetrahydrofuran 100 weight section and little hydroquinone were added, and the reaction was stopped. Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. This particle was enough washed in the tetrahydrofuran and the vacuum dryer performed reduced pressure drying.

[0226] (Installation of a polymerization nature vinyl group) the particle 5 weight section obtained by the toluene 80 weight section and the above-mentioned actuation by the separable flask — in addition, after making SONIKETA distribute enough, it stirred to homogeneity. Furthermore, the methacrylic-acid 5 weight section diluted with the toluene 10 weight section was added, and it stirred enough. Subsequently, the temperature up of the system was carried out to 60 degrees C, and the reaction was continued for 5 hours. Reaction mixture was taken out after reaction termination and reaction mixture was carried out to the particle the ** exception with the 3-micrometer membrane filter. Ethanol and an acetone washed this particle enough, and the vacuum dryer performed reduced pressure drying.

[0227] (Formation of the graft polymerization layer which has a long-chain alkyl group) The same actuation as an example 38 was performed. About the obtained particle, evaluation of dynamics reinforcement and an orientation condition was performed like the example 38. The result was shown in Table 6.

[0228] The example 42 (production of particle which has reducibility radical on front face) trimethylolpropane-triacrylate 50 weight section, the divinylbenzene 40 weight section, and the acrylonitrile 10 weight section were mixed to homogeneity, the carbon black 12 weight section was added to this, and stirring was performed for 48 hours using the bead mill. The benzoyl-peroxide 2 weight section was mixed into this monomer mixture at homogeneity, and this was further supplied to the 3% water-solution 850 weight section of polyvinyl alcohol. After stirring enough and performing grain refining, under the nitrogen air current, the temperature up was carried out to 80 degrees C, and the reaction was performed for 15 hours. Hot water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =8.0micrometer and CV value =5.0, and were black. When surface analysis was performed in TOF-SIMS, the OH radical of the polyvinyl alcohol origin was checked on the front face. The next actuation was performed by making this particle into a seed particle child.

[0229] (Formation of the graft polymerization layer which has a functional group) The same actuation as an example 38 was performed.

(Installation of a polymerization nature vinyl group) The same actuation as an example 38 was performed.

(Formation of the graft polymerization layer which has a long-chain alkyl group) The same actuation as an example 38 was performed. About the obtained particle, evaluation of dynamics reinforcement and an orientation condition was performed like the example 38. The result was shown in Table 6.

[0230] The mixed liquor of the divinylbenzene 80 weight section, the hydroxyethyl methacrylate 20 weight section, and the benzoyl-peroxide 2 weight section was added to the example 43 surface-active-agent high tenor's N-08 (Dai-ichi Kogyo Seiyaku Co., Ltd. make) 3% water-solution 800 weight section, it agitated with the homogenizer, and grain refining was performed. The temperature up was carried out to 80 degrees C under the nitrogen air current, agitating after that, and the reaction was performed for 15 hours. Hot water and a methanol performed classification actuation for the obtained particle after washing. The obtained particles were mean-particle-diameter =8.0micrometer and CV value =5.0. When surface analysis was performed in TOF-SIMS, the OH radical of the hydroxyethyl methacrylate origin was checked on the front face. The next actuation was performed by making this particle into a seed particle child.

[0231] (Formation of the graft polymerization layer which has a functional group) The same

actuation as an example 38 was performed.

(Installation of a polymerization nature vinyl group) The same actuation as an example 38 was performed.

(Formation of the graft polymerization layer which has a long-chain alkyl group) The same actuation as an example 38 was performed. About the obtained particle, evaluation of dynamics reinforcement and an orientation condition was performed like the example 38. The result was shown in Table 6.

[0232] The same actuation as example of comparison 17 (production of the particle which has a reducibility radical on a front face) example 38 was performed.

(Formation of the graft polymerization layer which has a functional group) The same actuation as an example 38 was performed.

(Installation of a polymerization nature vinyl group) The same actuation as an example 38 was performed.

[0233] (Formation of the graft polymerization layer which has a long-chain alkyl group) The same actuation as an example 38 was performed except having used the methyl methacrylate 50 weight section instead of stearyl methacrylate. It evaluated about dynamics reinforcement and an orientation condition as well as [particle / which was obtained] an example 38. The result was shown in Table 6.

[0234]

	力率濃度 (K100)	反応生成物 白濁による 低減の程度 (%)
実施例 3.8	4.50	異常配向発生せず
実施例 3.9	4.50	粒子の1部に異常配向発生
実施例 4.0	4.50	異常配向発生せず
実施例 4.1	4.50	異常配向発生せず
実施例 4.2	4.00	異常配向発生せず
実施例 4.3	4.20	異常配向発生せず
比較例 1.7	4.50	粒子全面に異常配向発生

[0235]

[Effect of the Invention] Functionality, such as abnormality orientation prevention engine performance, is given holding the dynamics reinforcement needed for a spacer, since the spacer for liquid crystal display components of this invention consisted of an above-mentioned configuration. For this reason, if the spacer for liquid crystal display components of this invention is used, the adhesion of the abnormality orientation phenomenon of liquid crystal and a spacer, spraying nature, etc. can be improved easily, and the liquid crystal display component from which a homogeneous and good image is obtained can be offered.

[Translation done.]

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1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.*** shows the word which can not be translated.

3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the type section Fig. showing the liquid crystal display component of this invention.

[Description of Notations]

- 1 Seal Member
- 2 Transparence Substrate
- 3 Transparent Electrode
- 4 Orientation Control Film
- 5 Transparence Substrate
- 6 Transparent Electrode
- 7 Orientation Control Film
- 8 Substrate
- 9 Spacer
- 10 Substrate
- 11 Pneumatic Liquid Crystal
- 12 Polarization Sheet
- 13 Polarization Sheet

[Translation done.]